



PRODUCT SPECIFICATION

MONO LCD MODULE MODEL: G1206B5FSW7B-J0 Ver:1.0

- < ◇ > Preliminary Specification
- < ◆ > Finally Specification

CUSTOMER'S APPROVAL	
CUSTOMER :	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWED	PD REVIEWED	PREPARED By

Revision Status

Version	Revise Date	Page	Content	Modified By
Ver. 1.0	2013-1-23		First Issued	

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1. Features

The features of LCD are as follows

- * Display mode : FSTN/Transflective/Positive
- * Drive IC : AIP31107&AIP31108
- * Interface Input Data : 8-Bits
- * Driving Method : 1/64Duty, 1/6 Bias
- * Viewing Direction : 12 O'clock
- * Backlight : LED (White)
- * Sample NO. : G1206B5FSW7B-J0_01/20130119

2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	93(W) x 70(H) x 13max(D)	mm
Number of Dots	128x64 Dots	
Viewing Area	70.2(W) x 38.8(H)	mm
Activity Area	66.52(W)x33.24(H)	mm
Dot Size	0.48(W) x 0.48(H)	mm
Dot Pitch	0.52(W) x0.52(H)	mm

3. ELECTRICAL SPECIFICATIONS

3-1 ABSOLUTR MAZIMUM RATINGS (Ta = 25 °C)

Item	Symbol	Standard Value			Unit
		Min.	Typ.	Max.	
Supply Voltage For Logic	$V_{DD} - V_{SS}$	0.3	-	7.0	V
Supply Voltage For LCD Drive	$V_{OP} = V_{DD} - V_0$	$V_{EE} - 0.3$	-	$V_{DD} + 0.3$	V
Input Voltage	V_{in}	-	-	-	V
Operating Temp.	Top	-20	-	+70	°C
Storage Temp.	Tst	-30	-	+80	°C

*. NOTE: The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

3-2 ELECTRICAL CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
Logic supply Voltage	$V_{DD} - V_{SS}$	$T_a = 25\text{ }^\circ\text{C}$ $V_{DD}=5V \pm 10\%$	4.5	5	5.5	V	
LCD Drive	$V_{OP}=V_{DD}-V_0$		8.1	8.4	8.7	V	
Input Voltage	"H" Level		V_{IH}	$0.7V_{DD}$	-	V_{DD}	V
	"L" Level		V_{IL}	0	-	$0.3 V_{DD}$	V
Frame Frequency	f_{FLM}		-	78	-	Hz	
Current Consumption	I_{DD}		-	13	-	mA	

3-3. BACKLIGHT

3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	$T_a = 25\text{ }^\circ\text{C}$	-	60	80	mA
Reverse Voltage	VR		-	-	5	V
Power Dissipation	PD		-	-	264	mW

3-3-2. Electrical-optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	$V_F=3.1V$ $T_a = 25\text{ }^\circ\text{C}$	-	60	-	mA
Average Luminous Intensity	Iv		200	-	-	cd/m ²
Color Coordinate	x		0.26	0.30	0.33	nm
	Y		0.26	0.30	0.33	
Lifetime		$I_f=60mA$	18000	20000	-	Hours

The brightness is measured without LCD panel

For operation above 25°C, The I_{fm} I_{fp} & P_d must be derated, the current derating is $-0.36mA/^\circ C$ for DC drive and $-0.86 mA/^\circ C$ for Pulse drive, the Power dissipation is $-0.75mW/^\circ C$.

The product working current must not more than the 60% of the I_{fm} or I_{fp} according to the working temperature.

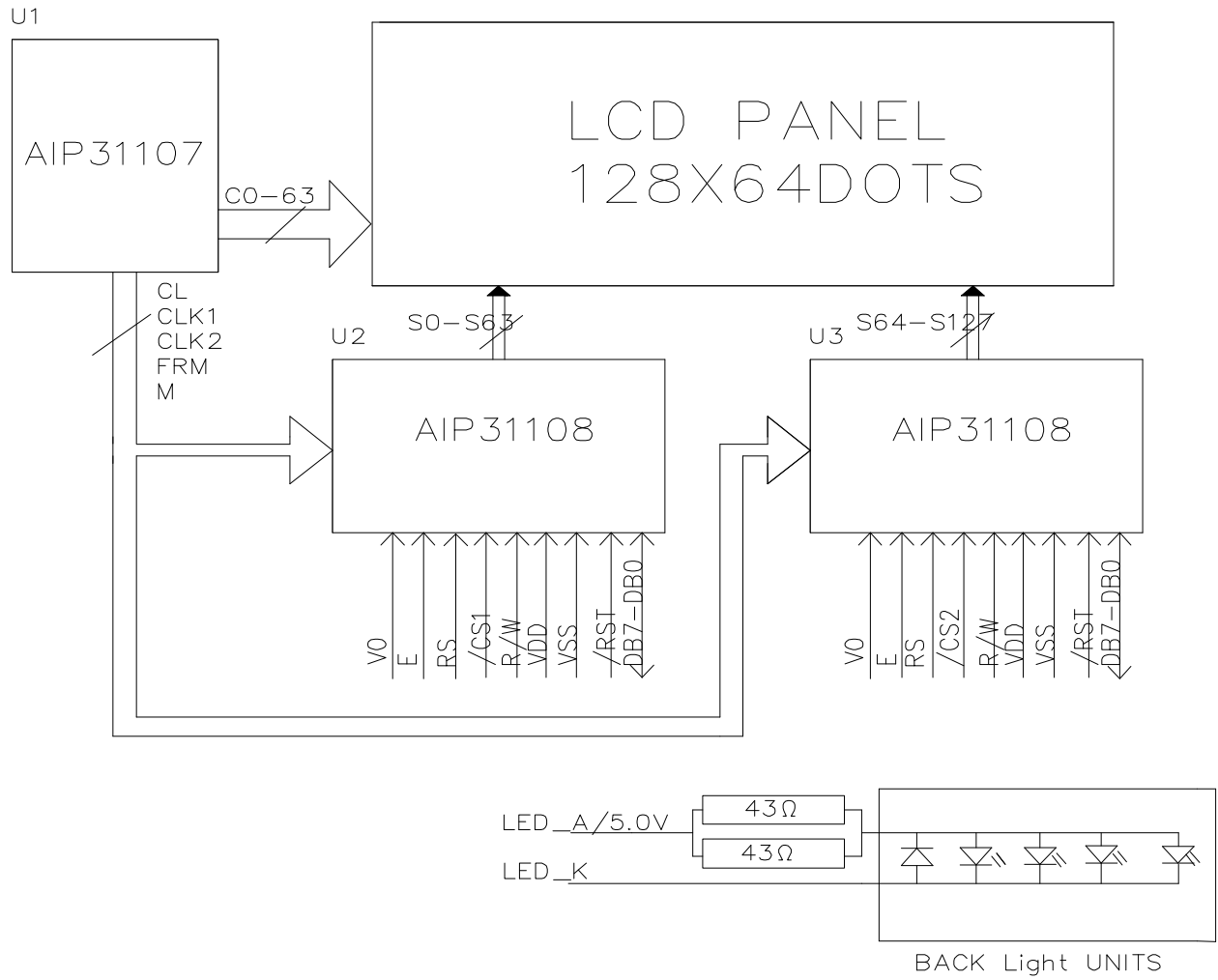
Backlight lifetime means luminance value larger than half of the original after 20000 hours' continuous working.

4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

4-1. INTERFACE PIN FUNCTION DESCRIPTION

PIN NO.	SYMBOL	FUNCTIONS
1	VSS	Ground (0V)
2	VDD	Supply voltage for logical circuit(5V)
3	V0	Supply voltage for LCD driving
4	RS	Select register signal
5	R/W	H: Data Read (LCM to MPU) ; L: Data Write (MPU to LCM)
6	E	Enable Signal
7~14	DB0~DB7	Data bus line
15	/CS1	Chip Selection Signal for U2
16	/CS2	Chip Selection Signal for U3
17	/RST	Reset (Active "LOW")
18	VEE	Negative voltage supply pin
19	LED_A	Backlight (+5V)
20	LED_K	Backlight (-)

4-2. BLOCK DIAGRAM



5. TIMING CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
E Cycle	t_c	1000	—	—	ns
E High Level Width	t_{WH}	450	—	—	ns
E Low Level Width	t_{WL}	450	—	—	ns
E Rise Time	t_R	—	—	25	ns
E Fall Time	t_F	—	—	25	ns
Address Set-Up Time	t_{ASU}	140	—	—	ns
Address Hold Time	t_{AH}	10	—	—	ns
Data Set-Up Time	t_{DSU}	200	—	—	ns
Data Delay Time	t_D	—	—	320	ns
Data Hold Time (Write)	t_{DHW}	10	—	—	ns
Data Hold Time (Read)	t_{DHR}	20	—	—	ns

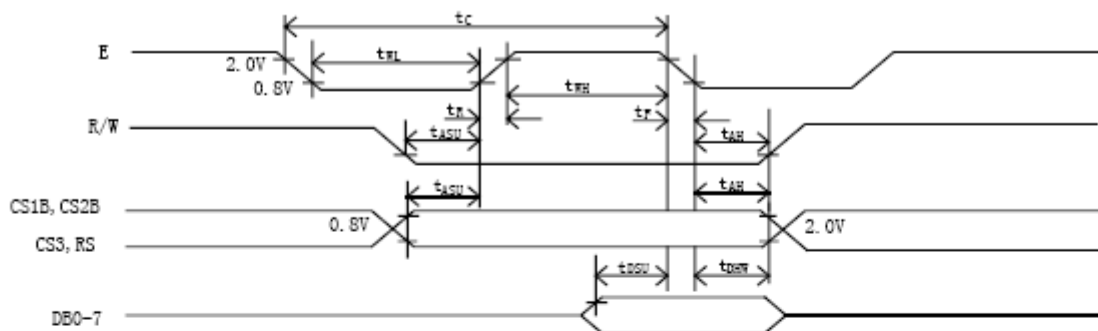


Fig 3. MPU write timing

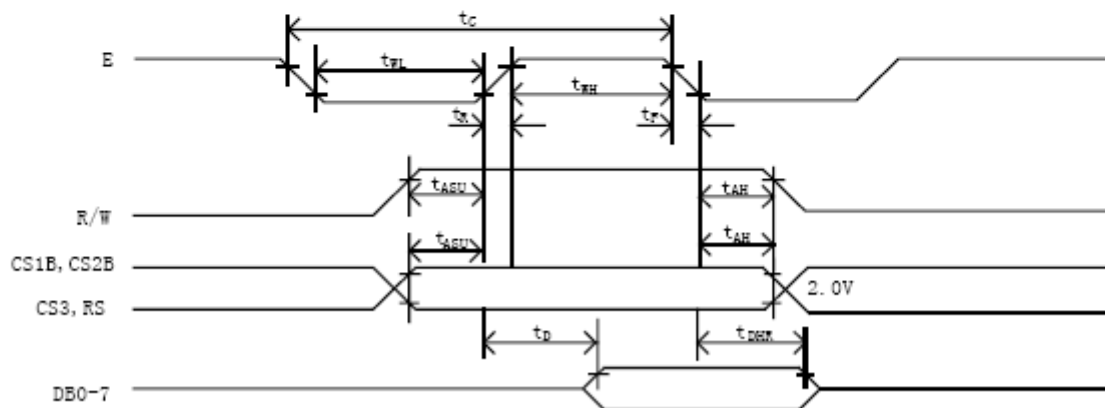


Fig 4. MPU Read timing

6. INSTRUCTION SET

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	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display ON/OFF	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF, H:ON
Set Address (Y address)	L	L	L	H	Y address (0~63)						Sets the Y address in the Y address counter.
Set Page (X address)	L	L	H	L	H	H	H	Page (0-7)			Sets the X address at the X address register.
Display Start Line (Z address)	L	L	H	H	Display start line (0-63)						Indicates the display data RAM displayed at the top of the screen.
Status Read	L	H	busy	L	On/off	reset	L	L	L	L	Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal H: Reset
Write Display Data	H	L	Write Data								Writes data (DB0:7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read Display Data	H	H	Read Data								Reads data (DB0:7) from display data RAM to the data bus.

1. Display On/Off

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

The display data appears when D is 1 and disappears when D is 0.

Though the data is not on the screen with D=0, it remains in the display data RAM.

Therefore, you can make it appear by changing D=0 into D=1.

2. Set Address (Y Address)

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

Y address (AC0 ~ AC5) of the display data RAM is set in the Y address counter.

An address is set by instruction and increased by 1 automatically by read or write operations of display data.

3. Set Page (X Address)

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

X address(AC0 ~ AC2) of the display data RAM is set in the X address register.

Writing or reading to or from MPU is executed in this specified page until the next page is set.

4. Display Start Line (Z Address)

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

Z address (AC0 ~ AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen. When the display duty cycle is 1/64 or others(1/32 ~ 1/64), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed.

5. Status Read

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BUSY	0	ON/OFF	RESET	0	0	0	0

- **BUSY**
When BUSY is 1, the Chip is executing internal operation and no instructions are accepted.
When BUSY is 0, the Chip is ready to accept any instructions.
- **ON/OFF**
When ON/OFF is 1, the display is on.
When ON/OFF is 0, the display is off.
- **RESET**
When RESET is 1, the system is being initialized. In this condition, no instructions except status read can be accepted.
When RESET is 0, initializing has finished and the system is in the usual operation condition.

6. Write Display Data

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

Writes data (D0 ~ D7) into the display data RAM.
After writing instruction, Y address is increased by 1 automatically.

7. Read Display Data

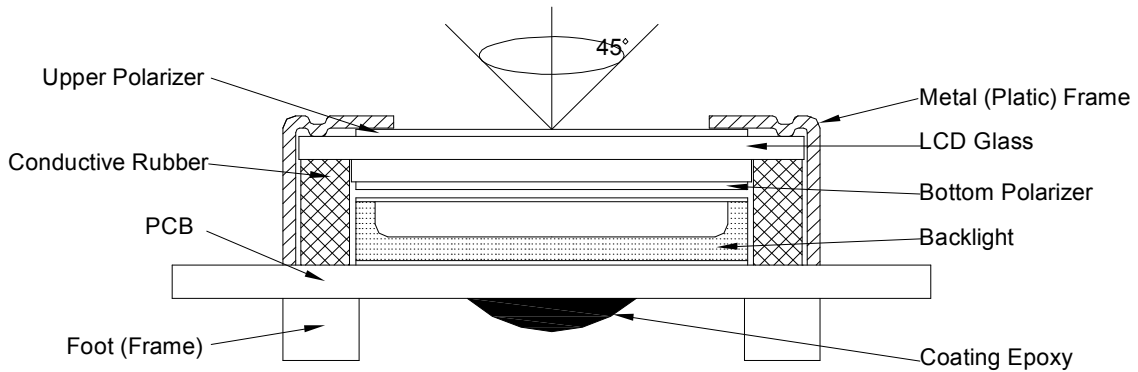
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Reads data (D0 ~ D7) from the display data RAM.
After reading instruction, Y address is increased by 1 automatically.

7. QUALITY SPECIFICATIONS

7-1. LCM Appearance and Electric inspection Condition

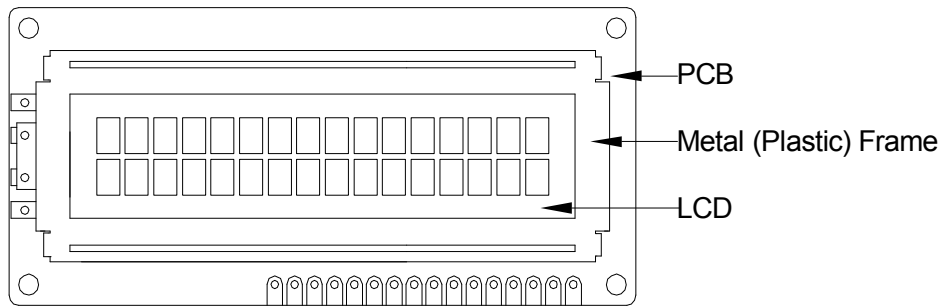
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



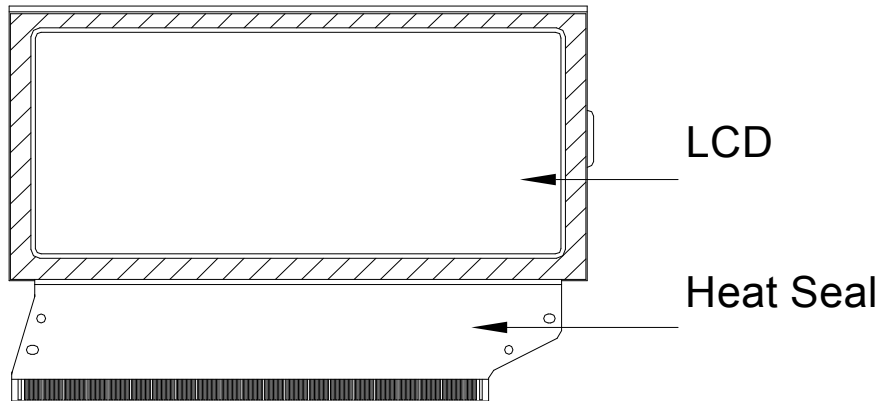
2. View Angle: with in 45° around perpendicular line.

7-2. Definition

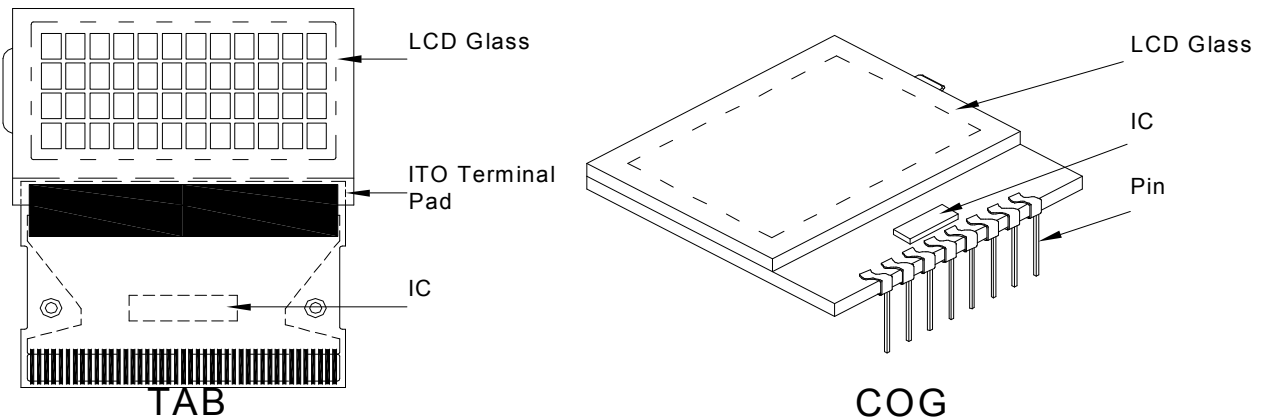
1. COB



2. Heat Seal



3. TAB and COG



7-3. Sampling Plan and Acceptance

1. Sampling Plan

MIL - STD - 105E (||) ordinary single inspection is used.

2. Acceptance

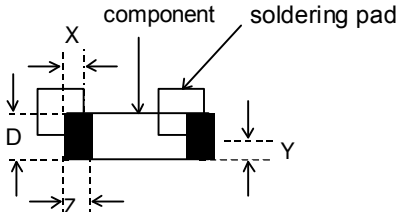
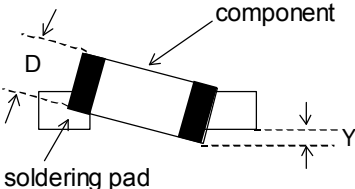
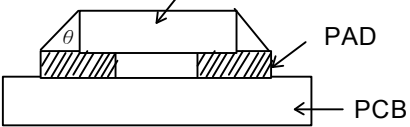
Major defect: AQL = 0.65%
Minor defect: AQL = 1.5%

7-4. Criteria

1. COB

Defect	Inspection Item	Inspection Standards	
Major	PCB copper flakes peeling off	Any copper flake in viewing Area should be greater than 1.0mm ²	Reject
Major	Height of coating epoxy	Exceed the dimension of drawing	Reject
Major	Void or hole of coating epoxy	Expose bonding wire or IC	Reject
Major	PCB cutting defect	Exceed the dimension of drawing	Reject

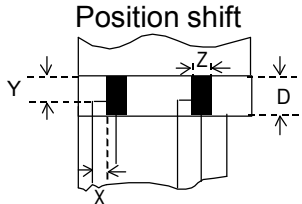
2. SMT

Defect	Inspection Item	Inspection Standards	
Minor	Component marking not readable		Reject
Minor	Component height	Exceed the dimension Of drawing	Reject
Major	Component solder defect (missing , extra, wrong component or wrong orientation)		Reject
Minor	Component position shift 	$X < 3/4Z$ $Y > 1/3D$	Reject Reject
Minor	Component tilt 	$Y > 1/3D$	Reject
Minor	Insufficient solder 	$\theta \leq 20^\circ$	Reject

3. Metal (Plastic) Frame

Defect	Inspection Item	Inspection Standards	
Major	Crack / breakage	Anywhere	
Minor	Frame Scratch	W	L
		w<0.1mm	Any
		0.1≤w<0.2mm	L≤5.0mm
		0.2≤w<0.3mm	L≤3.0mm
		w≥0.3mm	Any
		Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm. 2. Scratch on the back side of frame (not visible) can be ignored .	
Minor	Frame Dent , Prick $\Phi = \frac{L + W}{2}$		Acceptable of Dents / Pricks
		$\Phi \leq 1.0\text{mm}$	2
		$1.0 < \Phi \leq 1.5\text{mm}$	1
		$1.5\text{mm} < \Phi$	0
Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm 2. Dent / prick on the back side of frame (not visible) can be ignored			
Minor	Frame Deformation	Exceed the dimension of drawing	
Minor	Metal Frame Oxidation	Any rust	

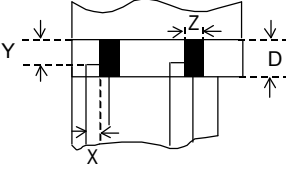
4. Flexible Film Connector (FFC)

Defect	Inspection Item	Inspection Standards	
Minor	Tilted soldering	Within the angle +5°	Acceptable
Minor	Uneven solder joint /bump		Reject
Minor	Hole $\Phi = \frac{L + W}{2}$	Expose the conductive line	Reject
		$\Phi > 1.0\text{mm}$	Reject
Minor		$Y > 1/3D$	Reject
		$X > 1/2Z$	Reject

5. Screw

Defect	Inspection Item	Inspection Standards	
Major	Screw missing/loosen		Reject
Minor	Screw oxidation	Any rust	Reject
Minor	Screw deformation	Difficult to accept screw driver	Reject

6. Heatseal 、TCP 、FPC

Defect	Inspection Item	Inspection Standards	
Major	Scratch expose conductive layer		Reject
Minor	HS Hole $\Phi = \frac{L+W}{2}$	$\Phi > 0.5\text{mm}$	Reject
Major	Adhesion strength	Less than the specification	Reject
Minor	Position shift 	$Y > 1/3D$	Reject
		$X > 1/2Z$	Reject
Major	Conductive line break		Reject

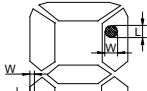
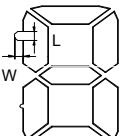
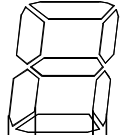
7. LED Backing Protective Film and Others

Defect	Inspection Item	Inspection Standards	
Minor	LED dirty, prick	Acceptable number of units	
		$\Phi \leq 0.10\text{mm}$	Ignore
		$0.10 < \Phi \leq 0.15\text{mm}$	2
		$0.15 < \Phi \leq 0.2\text{mm}$	1
		$\Phi > 0.2\text{mm}$	0
The distance between any two spots should be $\geq 5\text{mm}$ Any spot/dot/void outside of viewing area is acceptable			
Minor	Protective film tilt	Not fully cover LCD	Reject
Major	COG coating	Not fully cover ITO circuit	Reject

8. Electric Inspection

Defect	Inspection Item	Inspection Standards	
Major	Short		Reject
Major	Open		Reject

9. Inspection Specification of LCD

Defect	Inspect Item	Inspection Standards				
		W	W<0.03	0.03<W<0.05	W>0.05	
Minor	Linear Defect * Glass Scratch * Polarizer Scratch * Fiber and Linear material	L	L<5	L<3	Any	
		ACC. NO.	1	1	Reject	
		Note	L is the length and W is the width of the defect			
Minor	Black Spot and Polarizer Pricked * Foreign material between glass and polarizer or glass and glass * Polarizer hole or protuberance by external force	Φ	Φ<0.1	0.1<Φ<0.15	0.15<Φ<0.2	Φ>0.2
		ACC. NO.	3EA / 100mm ²	2	1	0
		Note	Φ is the average diameter of the defect. Distance between two defects > 10mm.			
		* Unobvious transparent foreign	Φ	Φ<0.3	0.3<Φ<0.5	0.5<Φ
			ACC.	-	-	-
		Φ	Φ<0.10	0.10<Φ<0.20	0.20<Φ<0.25	Φ>0.25
		ACC. NO.	3EA / 100mm ²	2	1	0
		Note	W is more than 1/2 segment width			Reject
			Φ = $\frac{L + W}{2}$ Distance between two defect is 10mm			
Minor	Protuberant Segment  Φ = (L + W) / 2	Φ	Φ<0.10	0.10<Φ<0.20	0.20<Φ<0.25	Φ>0.25
		W	Give	W<1/2 Seg W<0.2	W<1/2 Seg W<0.2	Ignore
		ACC. NO.	3EA / 100mm ²	2	1	0
Minor	Assembly Mis-alignm 	1. Segment				
		B	B<0.4mm	0.4<B<1.0mm	B>1.0mm	
		B-A	B-A<1/2B	B-A<0.2	B-A<0.25	
		Judge	Acceptable	Acceptable	Acceptable	
		2. Dot Matrix				
		Deformation>2°				Reject
Minor	Stain on LCD Panel Surface	Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: "Black spot" and "White Spot"				

8. RELIABILITY

NO.	Item	Condition	Criterion
1	High Temperature Operating	70°C, 96Hrs	No defect in cosmetic and operational function allowable.
2	Low Temperature Operating	-20°C, 96Hrs	
3	High Humidity	40°C, 90%RH, 96Hrs	
4	High Temperature Storage	80°C, 96Hrs	
5	Low Temperature Storage	-30°C, 96Hrs	
6	Vibration	Random wave 10 ~ 100Hz Acceleration: 2g 2 Hrs per direction(X,Y,Z)	Total current Consumption should be below double of initial value.
7	Thermal Shock	-20°C to25°C to70°C (60Min) (5Min) (60Min) 16Cycles	
8	ESD Testing	Contract Discharge Voltage: +1 ~ 4kV and -1 ~ -4kV	There will be discharged ten times at every discharging voltage cycle. The voltage gap is 1kV.
		Air Discharge Voltage: +1 ~ 6kV and -1 ~ -6kV	

Note: 1) Above conditions are suitable for our company standard products.
2) For restrict products, the test conditions listed as above must be revised.

9. HANDLING PRECAUTION

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers 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.

(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
- Trichloro trifluro thane

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

Do not use the following solvent:

- Water- Ketone- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS 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.

(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.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. 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.

Usage under the relative condition of 40°C, 50%RH or less is required.

(6) 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 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 polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

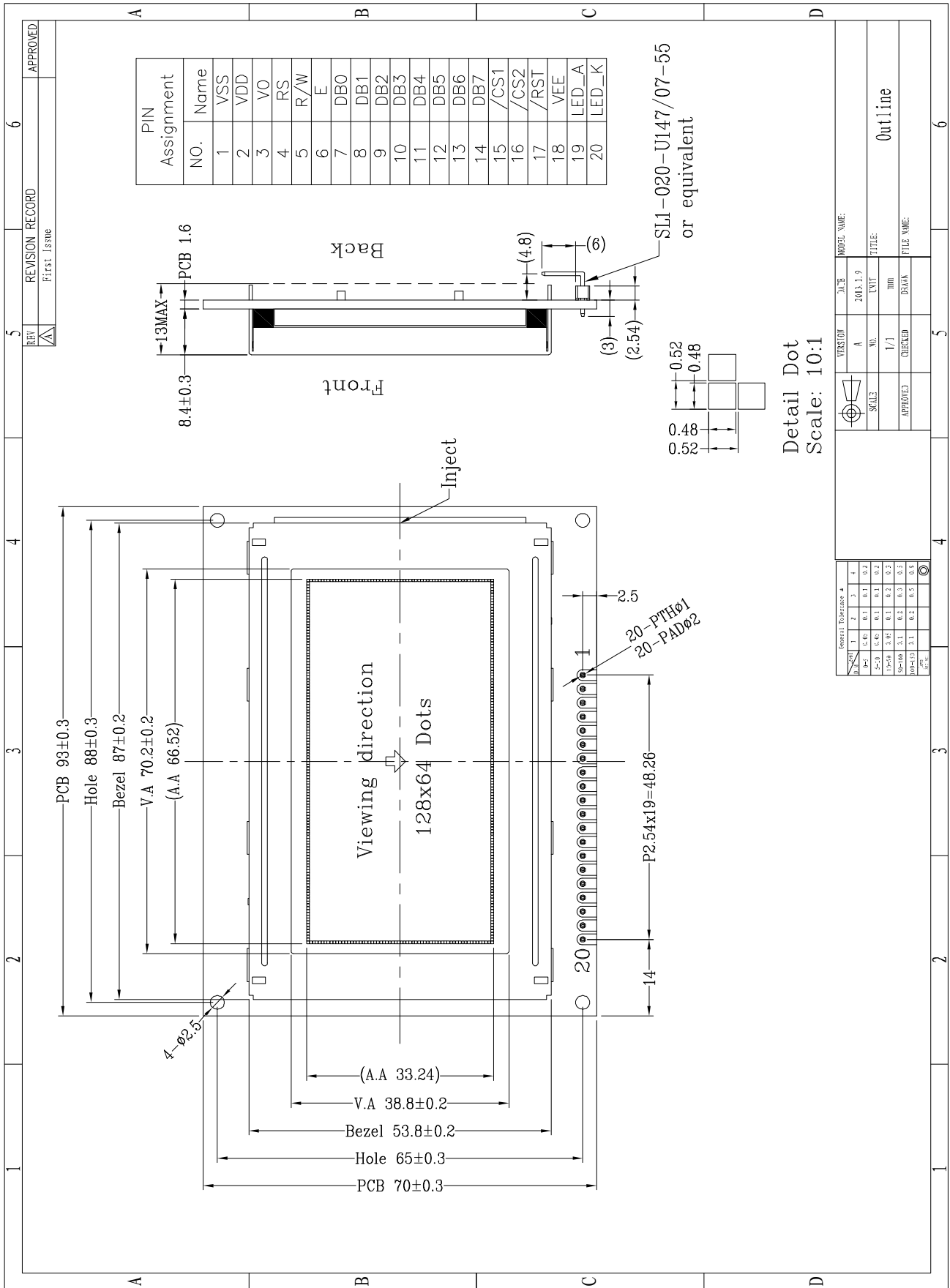
(7) Safety

- 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.

10. OUTLINE DIMENSION



PIN Assignment	
NO.	Name
1	VSS
2	VDD
3	VO
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	/CS1
16	/CS2
17	/RST
18	VEE
19	LED_A
20	LED_K

Detail Dot
Scale: 10:1

REV	DATE	DESCRIPTION	BY	CHK
1	2013.1.9	First Issue		

VERSION	DATE	MODEL NAME
A	2013.1.9	

SCALE	NO.	UNIT	TITLE
1/1		mm	Outline

APPROVED	CHECKED	DSM	FILE NAME