

ROHS**PRODUCT SPECIFICATION****MONO LCD MODULE**
MODEL: G2412A6SBY6B-A0 Ver:1.0

< ◇ > Preliminary Specification

< ◆ > Finally Specification

CUSTOMER'S APPROVAL	
CUSTOMER :	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWED	PD REVIEWED	PREPARED By

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1. Features

The features of LCD are as follows

- * Display mode : STN/Yellow-green/Transflective/Positive
- * Controller IC : T6963C
- Driver IC :SDN8080G
- * Interface Input Data : 8-Bit
- * Driving Method : 1/128 Duty, 1/12 Bias
- * Viewing Direction : 6 O'clock
- * Backlight : LED Unit (Yellow-Green)
- * Sample NO. :G2412A6SBY6B-A0_01/20110331

2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	144(W) x104(H) x 15(Max) (T)	mm
Number of Dots	240x 128 Dots	
View display area	114(W) x64(H)	mm
Activity Display Area	107.95(W)×57.55(H)	mm
Dot Size	0.4(W) x 0.4(H)	mm
Dot Pitch	0.45(W) x 0.45(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	V
Supply Voltage For LCD Drive	$V_{OP} = V_{DD} - V_0$	6	-	28	V
Input Voltage	V_{in}	-0.3	-	$V_{DD} + 0.3$	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	5.0	5.5	V	
LCD Drive	$V_{OP} = V_{DD} - V_0$		19.2	19.5	19.8	V	
Input Voltage	"H" Level		V_{IH}	V_{DD}	-	$0.2V_{DD}$	V
	"L" Level		V_{IL}	$0.8 V_{DD}$	-	V_{DD}	V
Frame Frequency	f_{FLM}		60	-	-	Hz	
Current Consumption	I_{DD}		-	54	-	mA	

3-3. BACKLIGHT

3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	$T_a = 25\text{ }^\circ\text{C}$	-	-	720	mA
Reverse Voltage	VR		-	-	10	V
Power Dissipation	PD		-	-	7200	mW

3-3-2. Electrical-optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	VF	$I_f = 720\text{mA}$ $T_a = 25\text{ }^\circ\text{C}$	4	4.2	4.4	V
Average Luminous Intensity	I_v		100	-	-	cd/m^2
Peak wave length	λ_p		568	571	574	nm

The brightness is measured without LCD panel

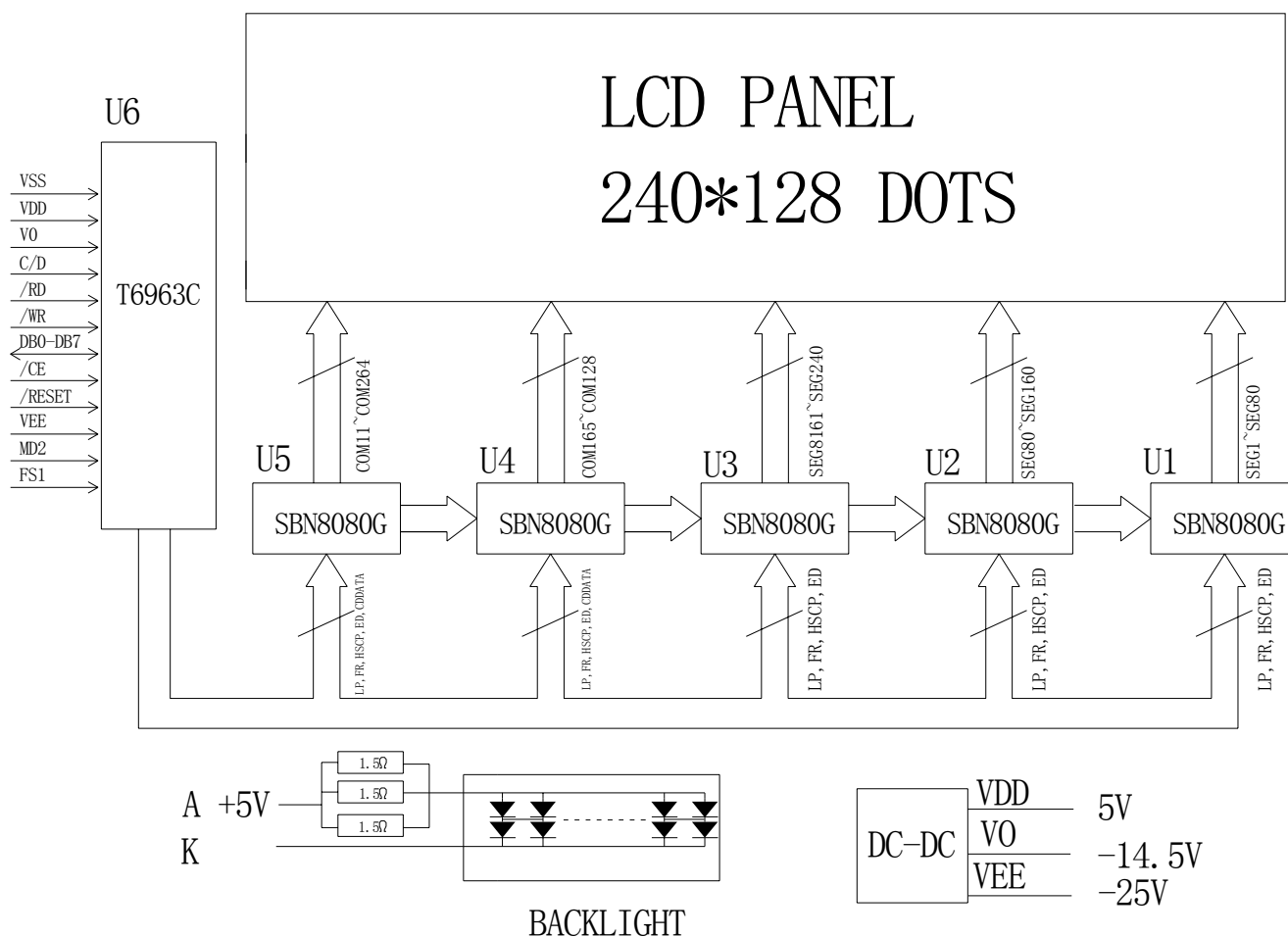
For operation above $25\text{ }^\circ\text{C}$, The I_{fm} & P_d must be derated, the current derating is $-0.36\text{mA}/^\circ\text{C}$ for DC drive and $-0.86\text{mA}/^\circ\text{C}$ for Pulse drive, the Power dissipation is $-0.75\text{mW}/^\circ\text{C}$. The product working current must not more than the 60% of the I_{fm} or I_{fp} according to the working temperature.

4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

4-1. INTERFACE PIN FUNCTION DESCRIPTION

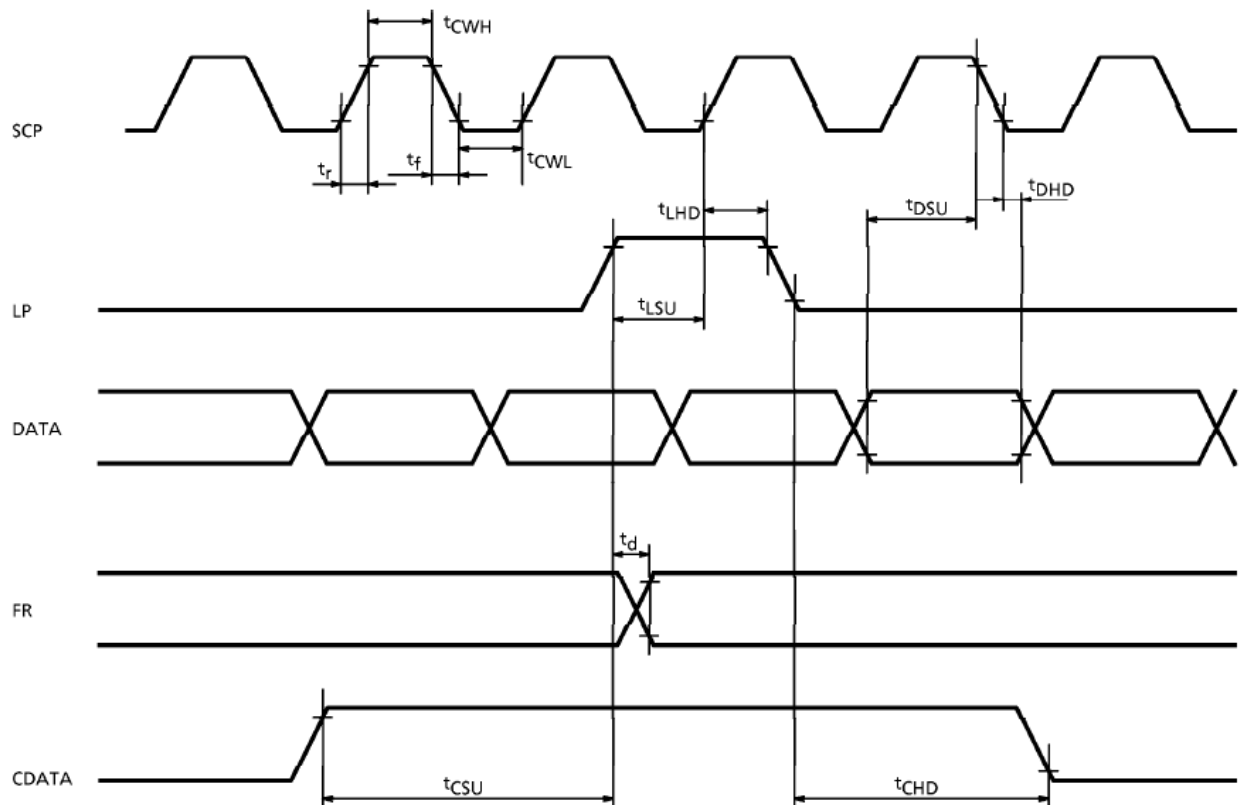
PIN NO.	SYMBOL	FUNCTIONS
1	Vss	Ground (0V)
2	VDD	Supply voltage for logical circuit(5V)
3	VO	Supply voltage for LCD driving
4	C/D	Serial clock or data input
5	/RD	Read enable signal
6	/WR	Write enable signal
7-14	DB0~DB7	Data bus line
15	/CE	Chip selection signal
16	/RESET	Reset signal
17	VEE	Voltage for LCD drive
18	MD2	Pin for selection of number of columns
19	FS1	Font selection pin
20	A	Backlight (+5V)

4-2. BLOCK DIAGRAM



5. TIMING CHARACTERISTICS

• Switching Characteristics (1)

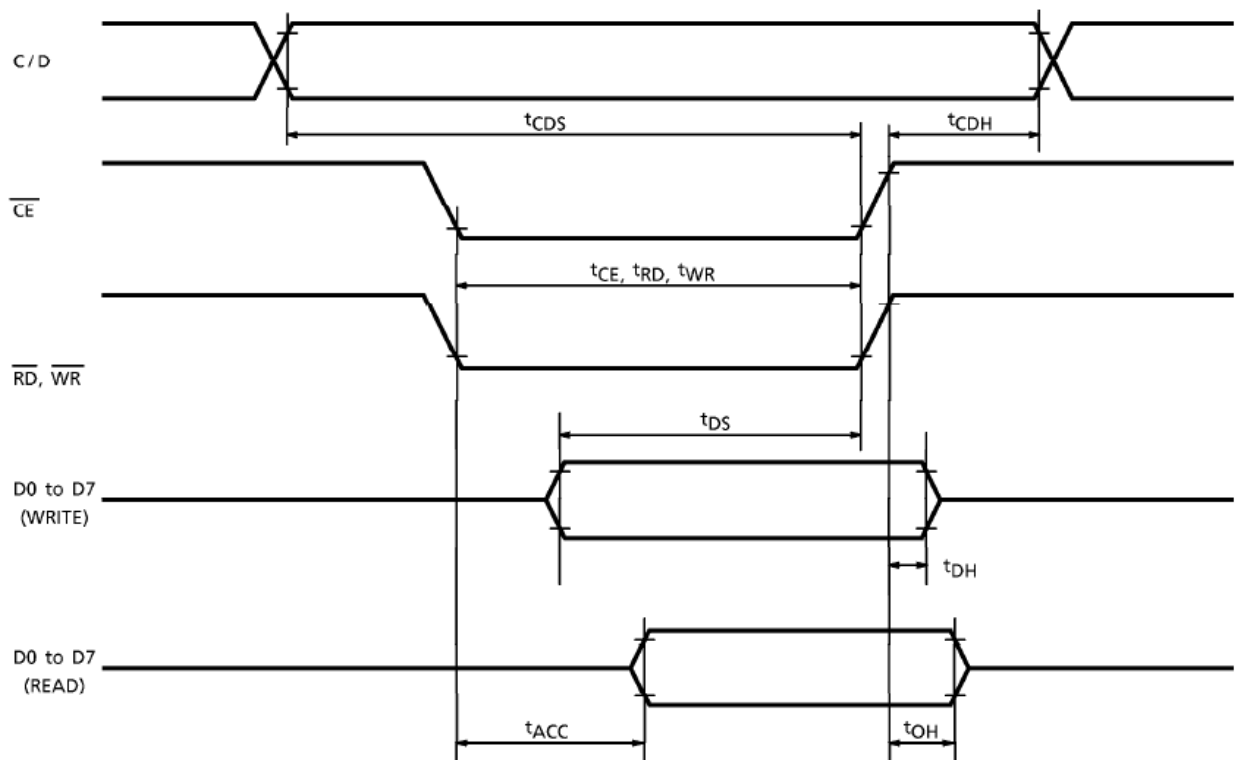


TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, $T_a = -20$ to $70^\circ C$)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Operating Frequency	f_{scp}	$T_a = -10 \sim 70^\circ C$	—	2.75	MHz
SCP Pulse Width	t_{CWH}, t_{CWL}	—	150	—	ns
SCP Rise / Fall Time	t_r, t_f	—	—	30	ns
LP Set-up Time	t_{LSU}	—	150	290	ns
LP Hold Time	t_{LHD}	—	5	40	ns
Data Set-up Time	t_{DSU}	—	170	—	ns
Data Hold Time	t_{DHD}	—	80	—	ns
FR Delay Time	t_d	—	0	90	ns
CDATA Set-up Time	t_{CSU}	—	450	850	ns
CDATA Hold Time	t_{CHD}	—	450	950	ns

- Switching Characteristics (2)

Bus Timing

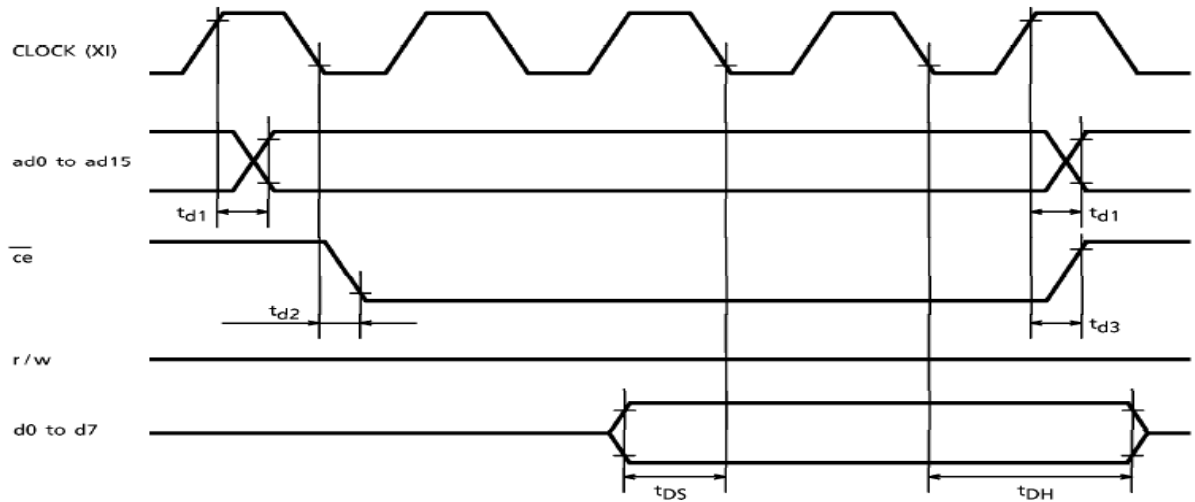


TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, $T_a = -20$ to $75^\circ C$)

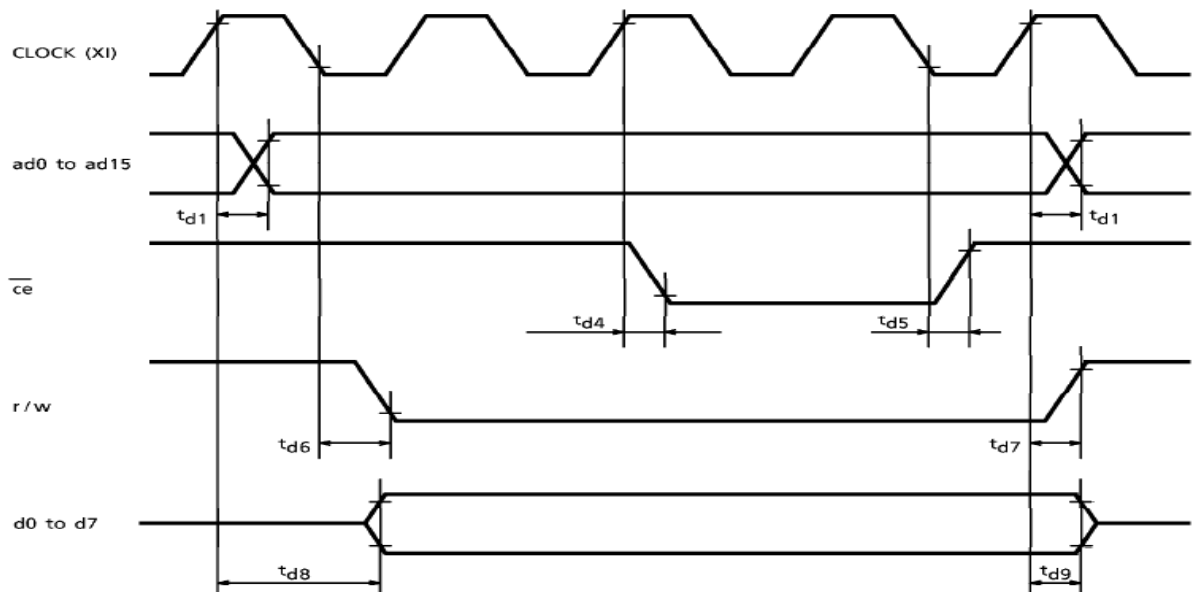
ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
C/D Set-up Time	t_{CDS}	—	100	—	ns
C/D Hold Time	t_{CDH}	—	10	—	ns
\overline{CE} , \overline{RD} , \overline{WR} Pulse Width	t_{CE}, t_{RD}, t_{WR}	—	80	—	ns
Data Set-up Time	t_{DS}	—	80	—	ns
Data Hold Time	t_{DH}	—	40	—	ns
Access Time	t_{ACC}	—	—	150	ns
Output Hold Time	t_{OH}	—	10	50	ns

- Switching Characteristics (3)

(1) External RAM Read mode



(2) External RAM Write mode



TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, $T_a = -20$ to $70^\circ C$)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Address Delay Time	t_{d1}	—	—	250	ns
\overline{ce} Fall Delay Time (Read)	t_{d2}	—	—	180	ns
\overline{ce} Rise Delay Time (Read)	t_{d3}	—	—	180	ns
Data Set-up Time	t_{DS}	—	0	—	ns
Data Hold Time	t_{DH}	—	30	—	ns
\overline{ce} Fall Delay Time (Write)	t_{d4}	—	—	200	ns
\overline{ce} Rise Delay Time (Write)	t_{d5}	—	—	200	ns
r/w Fall Delay Time	t_{d6}	—	—	180	ns
r/w Rise Delay Time	t_{d7}	—	—	180	ns
Data Stable Time	t_{d8}	—	—	450	ns
Data Hold Time	t_{d9}	—	—	200	ns

6. INSTRUCTION SET

COMMAND	CODE	D1	D2	FUNCTION
REGISTERS SETTING	00100001	X address	Y address	Set Cursor Pointer
	00100010	Data	00H	Set Offset Register
	00100100	Low address	High address	Set Address Pointer
SET CONTROL WORD	01000000	Low address	High address	Set Text Home Address
	01000001	Columns	00H	Set Text Area
	01000010	Low address	High address	Set Graphic Home Address
	01000011	Columns	00H	Set Graphic Area
MODE SET	1000X000	—	—	OR mode
	1000X001	—	—	EXOR mode
	1000X011	—	—	AND mode
	1000X100	—	—	Text Attribute mode
	10000XXX	—	—	Internal CG ROM mode
	10001XXX	—	—	External CG RAM mode
DISPLAY MODE	10010000	—	—	Display off
	1001XX10	—	—	Cursor on, blink off
	1001XX11	—	—	Cursor on, blink on
	100101XX	—	—	Text on, graphic off
	100110XX	—	—	Text off, graphic on
	100111XX	—	—	Text on, graphic on
CURSOR PATTERN SELECT	10100000	—	—	1-line cursor
	10100001	—	—	2-line cursor
	10100010	—	—	3-line cursor
	10100011	—	—	4-line cursor
	10100100	—	—	5-line cursor
	10100101	—	—	6-line cursor
	10100110	—	—	7-line cursor
	10100111	—	—	8-line cursor
DATA AUTO READ / WRITE	10110000	—	—	Set Data Auto Write
	10110001	—	—	Set Data Auto Read
	10110010	—	—	Auto Reset
DATA READ / WRITE	11000000	Data	—	Data Write and Increment ADP
	11000001	—	—	Data Read and Increment ADP
	11000010	Data	—	Data Write and Decrement ADP
	11000011	—	—	Data Read and Decrement ADP
	11000100	Data	—	Data Write and Nonvariable ADP
	11000101	—	—	Data Read and Nonvariable ADP
SCREEN PEEK	11100000	—	—	Screen Peek
SCREEN COPY	11101000			Screen Copy

X : invalid

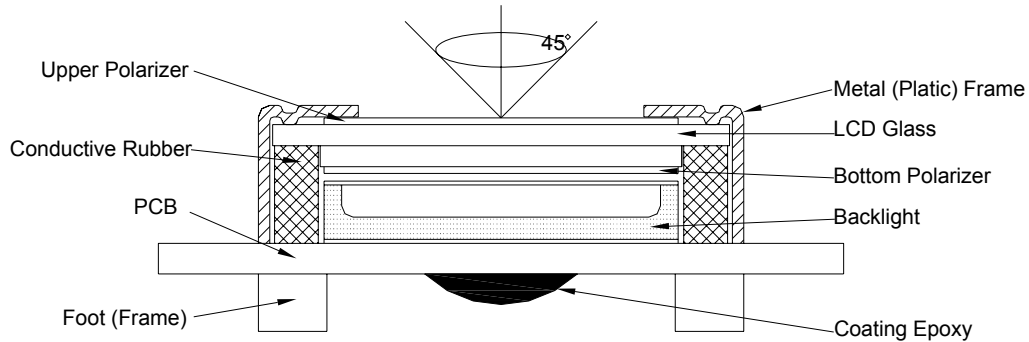
COMMAND	CODE	D1	D2	FUNCTION
BIT SET / RESET	11110XXX	—	—	Bit Reset
	11111XXX	—	—	Bit Set
	1111X000	—	—	Bit 0 (LSB)
	1111X001	—	—	Bit 1
	1111X010	—	—	Bit 2
	1111X011	—	—	Bit 3
	1111X100	—	—	Bit 4
	1111X101	—	—	Bit 5
	1111X110	—	—	Bit 6
	1111X111	—	—	Bit 7 (MSB)

X : invalid

7. QUALITY SPECIFICATIONS

8-1. LCM Appearance and Electric inspection Condition

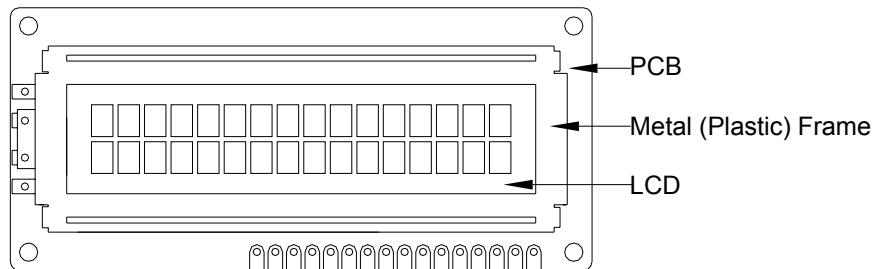
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



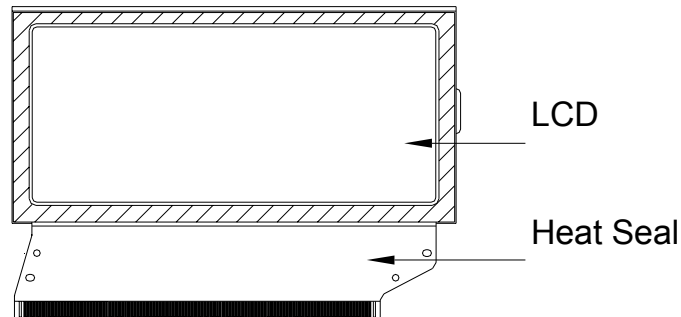
2. View Angle: with in 45° around perpendicular line.

8-2. Definition

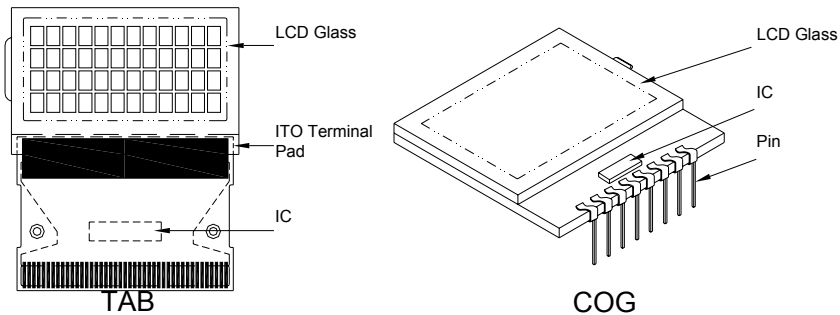
1. COB



2. Heat Seal



3. TAB and COG



8-3. Sampling Plan and Acceptance

1. Sampling Plan

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

2. Acceptance

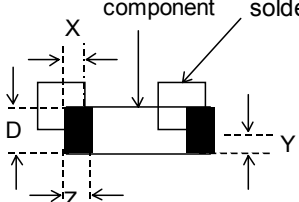
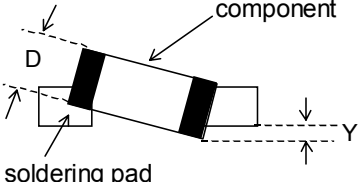
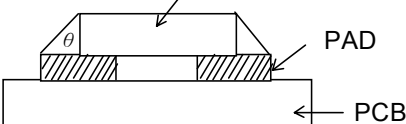
Major defect: AQL = 0.65%

Minor defect: AQL = 1.5%

8-4. 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

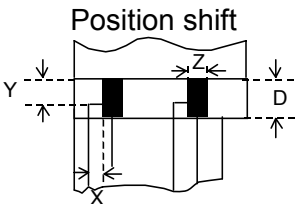
2. SMT

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		
			Reject	
Minor	Frame Scratch	W	L	Acceptable of Scratch
		$w < 0.1\text{mm}$	Any	Ignore
		$0.1 \leq w < 0.2\text{mm}$	$L \leq 5.0\text{mm}$	2
		$0.2 \leq w < 0.3\text{mm}$	$L \leq 3.0\text{mm}$	1
		$w > 0.3\text{mm}$	Any	0
		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		

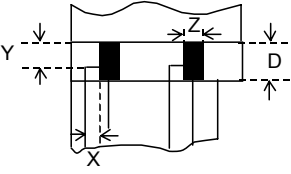
4. Flexible Film Connector (FFC)

Defect	Inspection Item	Inspection Standards	
Minor	Tilted soldering	Within the angle $+5^\circ$	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	 <p>Position shift</p>	$Y > 1/3D$	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

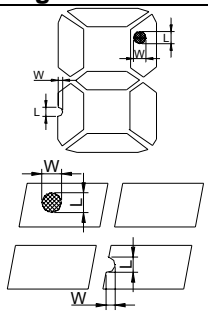
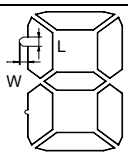
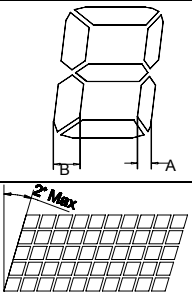
7. LED Backing Protective Film and Others

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	$W \leq 0.03$	$0.03 < W \leq 0.05$	$W > 0.05$	
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	$\Phi \leq 0.1$	$0.1 < \Phi \leq 0.15$	$0.15 < \Phi \leq 0.2$	$\Phi > 0.2$
		ACC. NO.	3EA / 100mm ²	2	1	0
		Note	Φ is the average diameter of the defect. Distance between two defects > 10mm.			
Minor	White Spot and Bubble in polarizer * Unobvious transparent foreign material between glass and glass or glass and polarizer * Air protuberance between polarizer and glass	Φ	$\Phi \leq 0.3$	$0.3 < \Phi \leq 0.5$	$0.5 < \Phi$	
		ACC. NO.	3EA / 100mm ²	1	0	
		Note	Φ is the average diameter of the defect. Distance between two defects > 10mm.			
Minor	Segment Defect 	Φ	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$	$\Phi > 0.25$
		ACC. NO.	3EA / 100mm ²	2	1	0
		Note	W is more than 1/2 segment width			Reject
			$\Phi = \frac{L + W}{2}$ Distance between two defect is 10mm			
Minor	Protuberant Segment  $\Phi = (L + W) / 2$	Φ	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$	$\Phi > 0.25$
		W	Glue	$W \leq 1/2$ Seg $W < 0.2$	$W \leq 1/2$ Seg $W < 0.2$	Ignore
		ACC. NO.	3EA / 100mm ²	2	1	0
Minor	Assembly Mis-alignment 	1. Segment				
		B	$B \leq 0.4\text{mm}$	$0.4 < B \leq 1.0\text{mm}$	$B > 1.0\text{mm}$	
		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. Total current Consumption should be below double of initial value.
2	Low Temperature Operating	-20°C, 96Hrs	
3	High Humidity	50°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)	
7	Thermal Shock	-20°C to 25°C to 70°C (60Min) (5Min) (60Min) 16Cycles	
8	ESD Testing	Contract Discharge Voltage: +1 ~ 5kV and -1 ~ -5kV Air Discharge Voltage: +1 ~ 8kV and -1 ~ -8kV	

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 reequired.

(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

