PRODUCT SPECIFICATION

128×64 DOTS MONO COG LCD MODULE
MODEL: LCM12864B-01S

< ◇> Preliminary Specification

< ◆> Finally Specification

CUSTOMER'S APPROVAL	
CUSTOMER :	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWD	PD REVIEWD	PREPARED By

Revision Status

Version	Revise Date	Page	Content	Modified By
Ver. 1.0	2010.04.21		First Issued	

Table of Contents

1. Features

The features of LCD are as follows

* Display mode : STN/Blue, Transmissive, Negative
* Drive IC : SPLC502B
* Display format : 128x64Dots
* Interface Input Data : 8-Bits
* Driving Method : 1/65 Duty, 1/9 Bias
* Viewing Direction : 12 O'clock
* Backlight : LED (White)
*Sample NO. : LCM12864B-01S /20100414

2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	93.8(W) x52.4(H) x 5.5MAX(D)	mm
Number of Dots	128 x 64 Dots	
View display area	72.5(H) x39(V)	Mm
Activity Display Area	66.52(H)x33.24(V)	mm
Dot Size	0.48(H) x0.48(V)	mm
Dot Pitch	0.52(H) x0.52(V)	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	-	3.6	V
Supply Voltage For LCD Drive	$V_{op}= V_O – V_{SS}$	0.3	-	12	V
Input Voltage	Vin	-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℃, and the back ground will become darker at high temperature operating.

3-2 ELECTICAL CHARACTERISTICS

Item		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Logic supply Voltage		V_{DD} - V_{SS}		2.2	3	3.3	V
LCD Drive		V_{OP}=Vo–V_{SS}		8.4	8.7	9.0	V
Input Voltage	"H" Level	V_{IH}	V_{DD}=3V ± 5%	0.8V_{DD}		V_{DD}	V
	"L" Level	V_{IL}		V_{SS}		0.2V_{DD}	V
Current Consumption		IDD		-	1.06	-	mA

3-3. BACKLIGHT

3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	Ta = 25 °C	-	-	90	mA
Reverse Voltage	VR			-	5	V
Power Dissipation	PD			-	306	mW

3-3-2. Electrical-optical Characteristics

Item	Symbol	Condition	Min.		Typ.		Max.		Unit
Forward Voltage	VF	If=90mA Ta = 25 °C	2.9		3.1		3.4		V
Average Luminous Intensity	Iv	Ta = 25 °C If=90mA	-		200		-		cd/m2
Colour Coordinates	-	IF=90mA Ta = 25 °C	X	Y	X	Y	X	Y	-
			0.24	0.24	-	-	0.33	0.33	

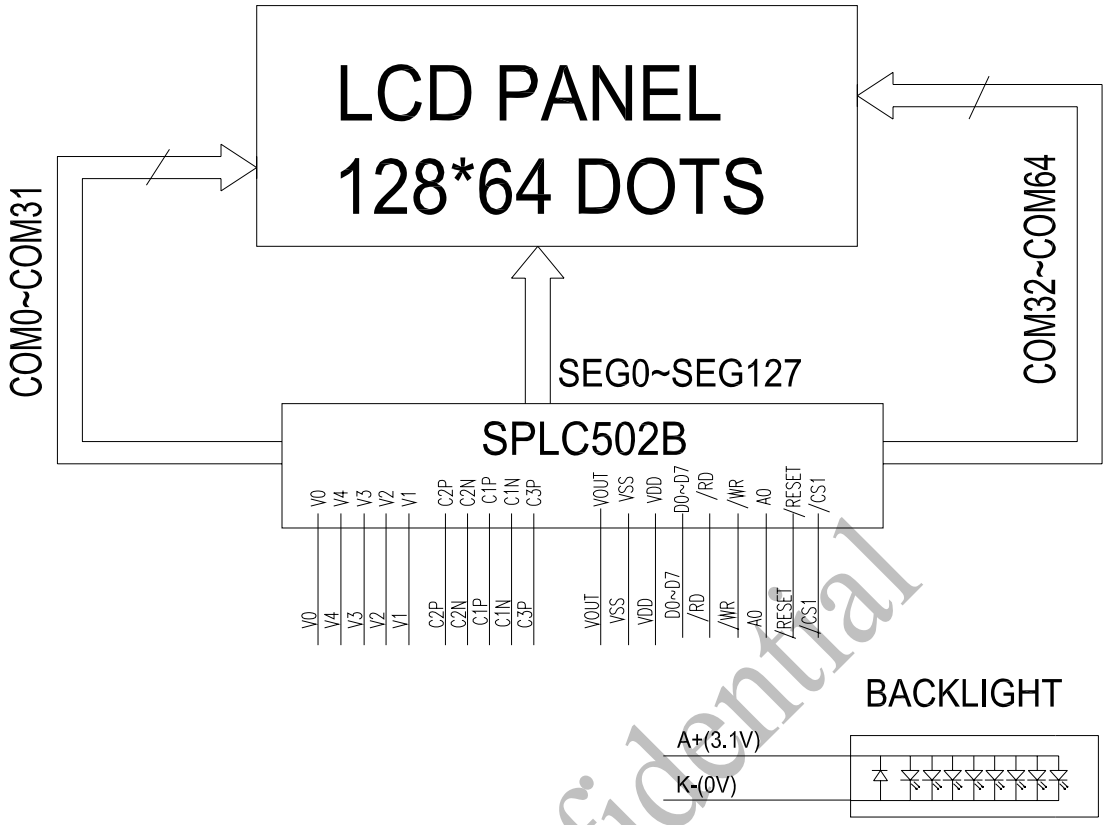
The brightness is measured without LCD panel

4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

4-1. INTERFACE PIN FUNCTION DESCRIPTION

PIN NO.	SYMBOL	FUNCIONS
1	/CS1	Chip enable
2	/RESET	Reset signal
3	A0	Command/data selection
4	/WR	Write signal
5	/RD	Read signal
6~13	D0~D7	Data bus
14	VDD	Power supply (+3.0V)
15	VSS	Power supply (ground)
16	VOUT	DC/DC voltage converter, a capacitor is connected between this terminal and Vss.
17	C3P	DC/DC voltage converter, a capacitor is connected between this terminal and C1P terminal
18	C1N	DC/DC voltage converter, a capacitor is connected between this terminal and C1N terminal
19	C1P	DC/DC voltage converter, a capacitor is connected between this terminal and C1P terminal.
20	C2P	DC/DC voltage converter, a capacitor is connected between this terminal and C2P terminal.
21	C2N	DC/DC voltage converter, a capacitor is connected between this terminal and C2N terminal.
22~26	V1~V4,V0	A multi-level power supply for liquid crystal drive
	A	LED+ 3.1v
	K	LED- 0V

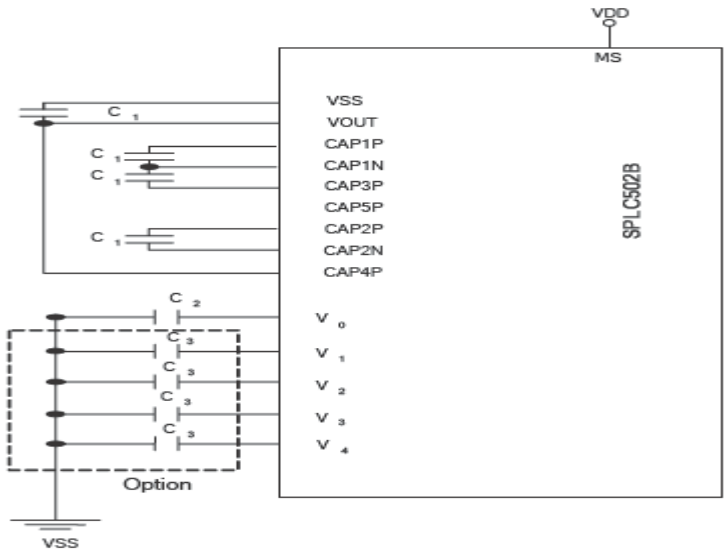
4-2. BLOCK DIAGRAM



4-3 POWER SUPPLY

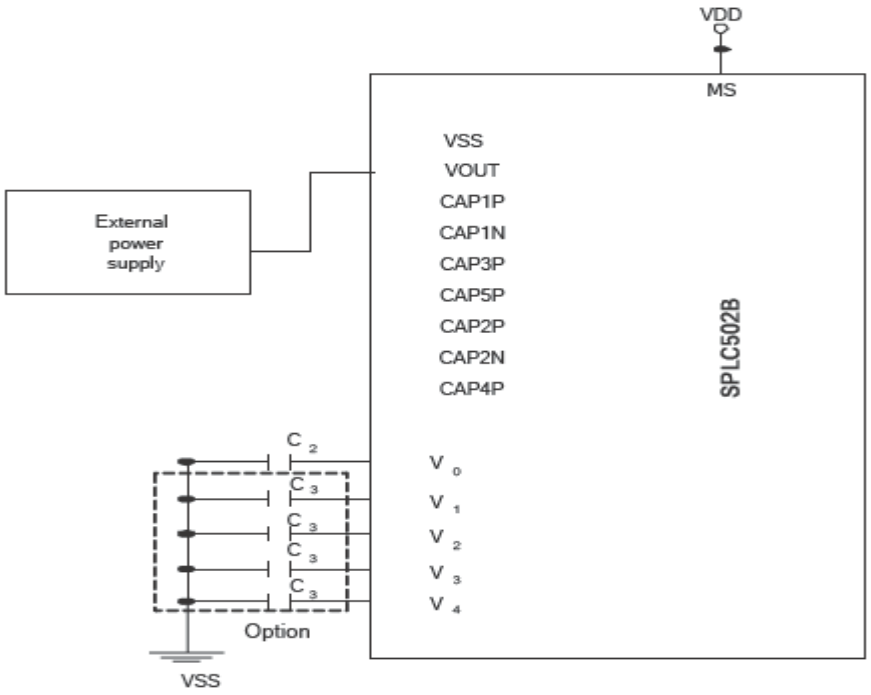
When using all of the step-up circuit, voltage regulating circuit and V/F circuit

When the voltage regulator internal resistor is used
Example where VDD2 = VDD, with 4x step-up



When the voltage regulator internal resistor is used .

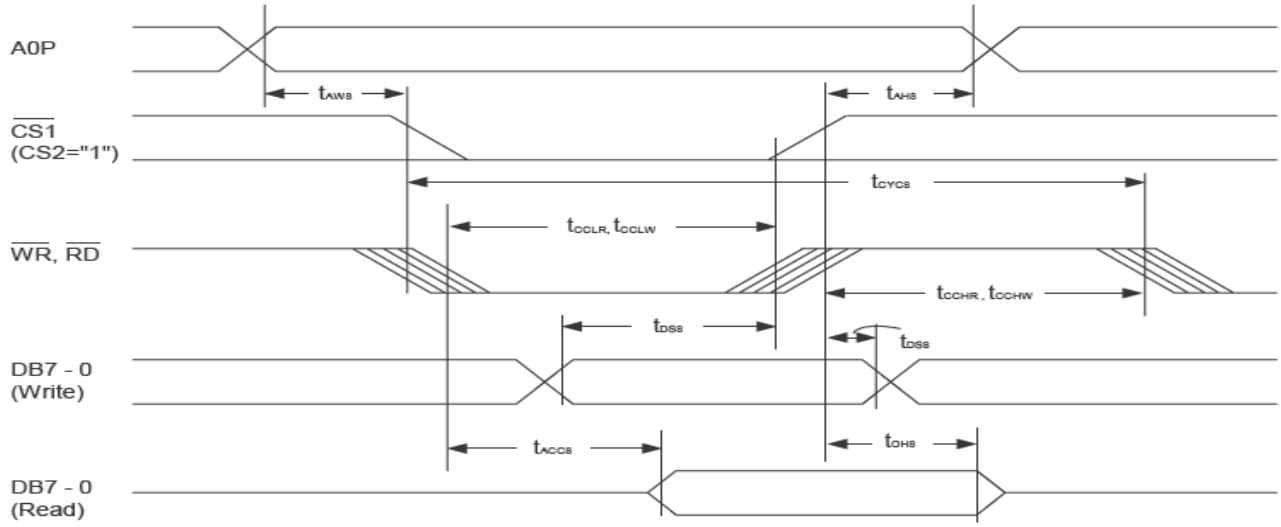
When the voltage regulator internal resistor is used



Item	Set Value	Units
C1	1.0 to 2.2	uF
C2	0.1 to 4.7	uF
C3	0.1 to 4.7	uF

5. TIMING CHARACTERISTICS

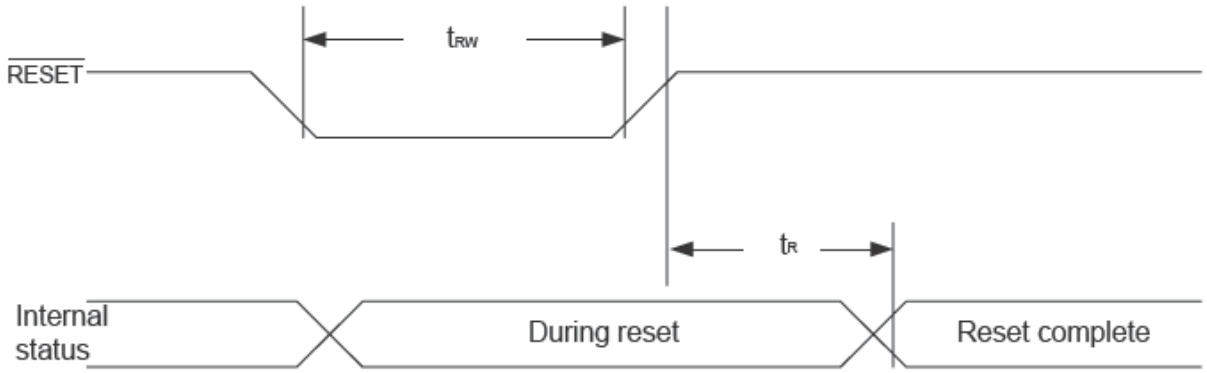
5.1 System bus read/write Characteristics (8080serias)



(VDD = 2.7V to 3.3V, T_A = -20 to 75℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0P	t_{AH8}		0	-	ns
Address setup time		t_{AW8}		0	-	ns
System cycle time	A0P	t_{CYC8}		400	-	ns
Control L pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCLW}		100	-	ns
Control L pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCLR}		100	-	ns
Control H pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCHW}		100	-	ns
Control H pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCHR}		100	-	ns
Data setup time	DB7 - 0	t_{DS8}		40	-	ns
Address hold time		t_{DH8}		15	-	ns
$\overline{RD}$ access time		t_{ACC8}	C_L = 100pF	-	140	ns
Output disable time		t_{OH8}		10	100	ns

5.2 The Reset Timing



(VDD = 2.7V to 3.3V, T_A = -20 to 75℃)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t_R	-	-	-	1.0	μs
Reset 'L' pulse width	RES	t_{RW}		1.0	-	-	μs

6. INSTRUCTION SET

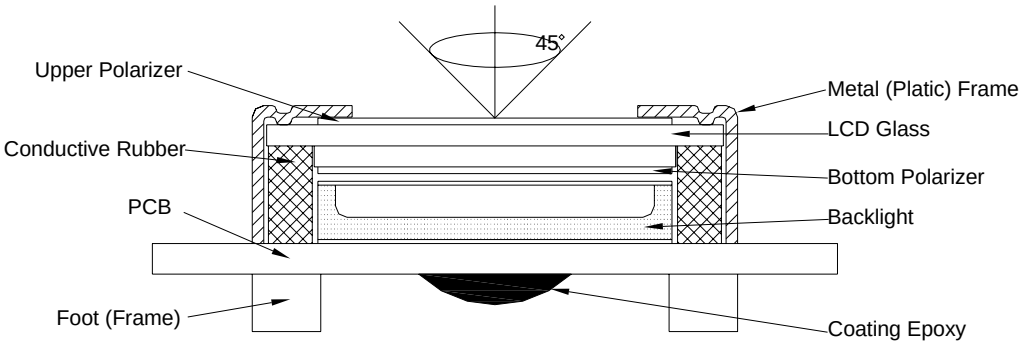
Command	Command Code											Function
	A0P	$\overline{RD}$	$\overline{WR}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
1). Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
2). Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
3). Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
4). Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Set the least significant 4 bits of the display RAM column address.
5). Status read	0	0	1	Status				0	0	0	0	Reads the status data
6). Display data write	1	1	0	Write data								Writes to the display RAM
7). Display data read	1	0	1	Read data								Reads from the display RAM
8). ADC select	0	1	0	1	0	1	0	0	0	0	0 1	Sets the display RAM address SEG output correspondence 0: normal, 1:reverse
9). Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/ reverse 0: normal, 1:reverse
10). Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
11). LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD driver voltage bias ratio SPLC502B.....0:1/9, 1:1/7
12). Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
13). End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
14). Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
15). Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction, 1: reverse direction
16). Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
17). V0 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio (Rb/Ra) mode
18). Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V0 output voltage electronic volume register
Electronic volume register set	0	1	0	*	*	Electronic volume value						

Command	Command Code											Function
	A0P	$\overline{RD}$	$\overline{WR}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
19). Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON
Static indicator Register set				*	*	*	*	*	*	Mode		Set the flashing mode
20). Page Blink	0	1	0	1	1	0	1	0	1	0	1	
Page selection	0	1	0	P7	P6	P5	P4	P3	P2	P1	P0	P7 - 0: 1 - blinking page 0 - no blinking, normal display
21). Driving Mode Set	0	1	0	1	1	0	1	0	0	1	0	Set the driving mode register
Mode selection	0	1	0	0	0	0	0	0	0	0	D0	Driving capability (D0): (1)>(0)
22). Power saver												Display OFF and display all points ON compound command
23). NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
24). Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command
				1	1	0	1	0	1	0	0	
25). Oscillator Frequency selection	0	1	0	1	1	1	0	0	1	0	0 1	20KHz/33KHz (Default) 16.4KHz/ 27.06KHz

7. QUALITY SPECIFICATIONS

7-1. LCM Appearance and Electric inspection Condition

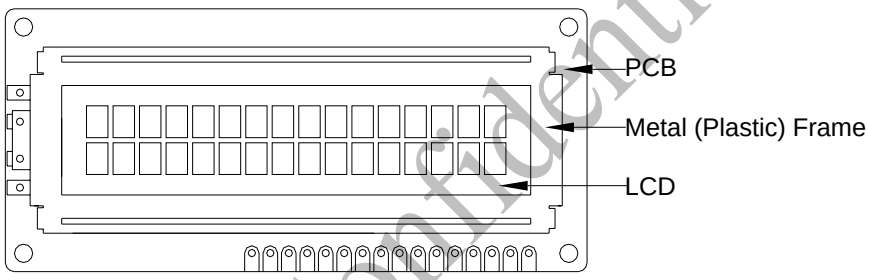
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



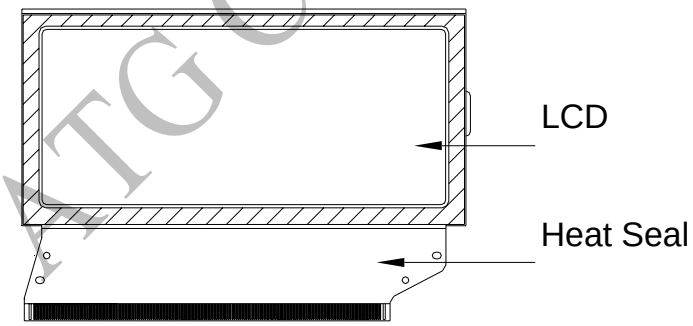
2. View Angle: with in 45˚around perpendicular line.

7-2. Definition

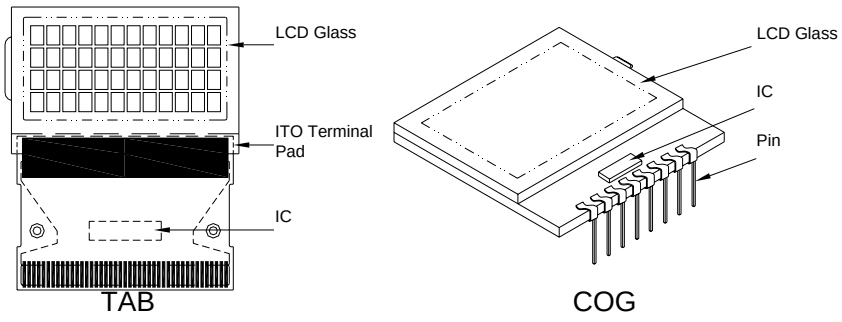
1. COB



2. Heat Seal



3. TAB and COG



7-3. Sampling Plan and Acceptance

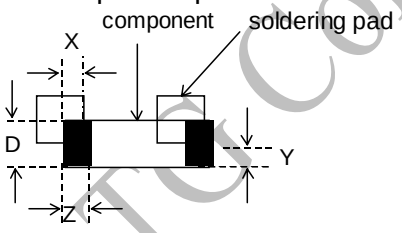
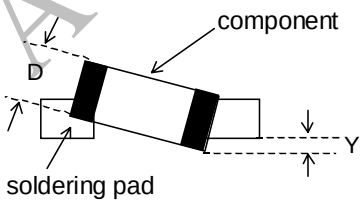
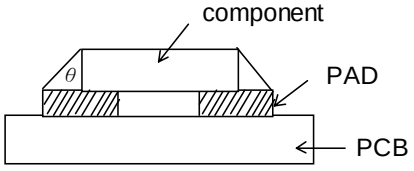
1. Sampling Plan
   MIL - STD - 105E (‖) ordinary single inspection is used.
2. Acceptance
   Major defect: AQL = 0.25%
   Minor defect: AQL = 0.65%

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

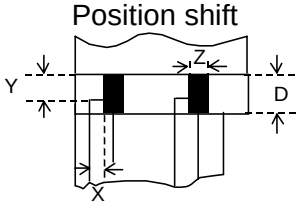
2. SMT

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		Reject
Minor	Frame Scratch	W	L	Acceptable of Scratch
		w<0.1mm	Any	Ignore
		0.1≤w<0.2mm	L≤5.0mm	2
		0.2≤w<0.3mm	L≤3.0mm	1
		w≥0.3mm	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
		Φ≤1.0mm		2
		1.0<Φ≤1.5mm		1
		1.5mm<Φ		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		

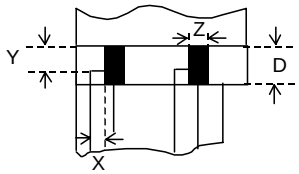
4. Flexible Film Connector (FFC)

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
		Φ > 1.0mm	Reject
Minor	Position shift 	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 $\Phi = \frac{L+W}{2}$	$\Phi > 0.5$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

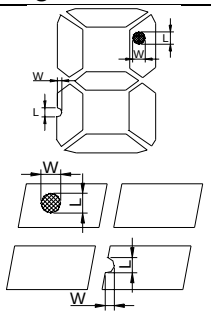
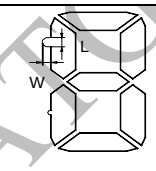
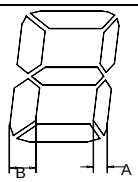
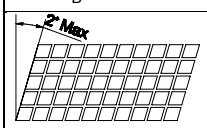
7. LED Backing Protective Film and Others

Defect	Inspection Item	Inspection Standards	
Minor	LED dirty, prick	Acceptable number of units	
		$\Phi \leq 0.10$mm	Ignore
		$0.10 < \Phi \leq 0.15$mm	2
		$0.15 < \Phi \leq 0.2$mm	1
		$\Phi > 0.2$mm	0
		The distance between any two spots should be ≥5mm 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				
Minor	Linear Defect	∗ Glass Scratch ∗ Polarizer Scratch ∗ Fiber and Linear material	W	W≤0.03		0.03<W≤0.05	W>0.05
			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.			
Minor	White Spot and Bubble in polarizer	∗ Unobvious transparant foreign material between glass and glass or glass and polarizer ∗ Air protuberance between polarizer and glass	Φ	Φ≤0.3		0.3<Φ≤0.5	0.5<Φ
			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	Φ≤0.10	0.10<Φ≤0.20	0.20<Φ≤0.25	Φ>0.25
			ACC. NO.	3EA / 100mm^2	2	1	0
			W is more than 1/2 segment width				Reject
			Note	$\Phi = \frac{L+W}{2}$ 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	Glue	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-alignment		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℃, 96Hrs	No defect in cosmetic and operational function allowable. Total current Consumption should be below double of initial value.
2	Low Temperature Operating	-20℃, 96Hrs	
3	High Humidity	60℃, 90%RH, 96Hrs	
4	High Temperature Storage	80℃, 96Hrs	
5	Low Temperature Storage	-30℃, 96Hrs	
6	Vibration	Random wave 10 ~ 100Hz Acceleration: 2g 2 Hrs per direction(X,Y,Z)	
7	Thermal Shock	-20℃ to25℃ to70℃ (60Min) (5Min) (60Min) 16Cycles	
8	ESD Testing	Contract Discharge Voltage: +1 ~ 5kV and –1 ~ –5kV	There will be discharged ten times at every discharging voltage cycle. The voltage gap is 1kV.
		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 trifloro 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

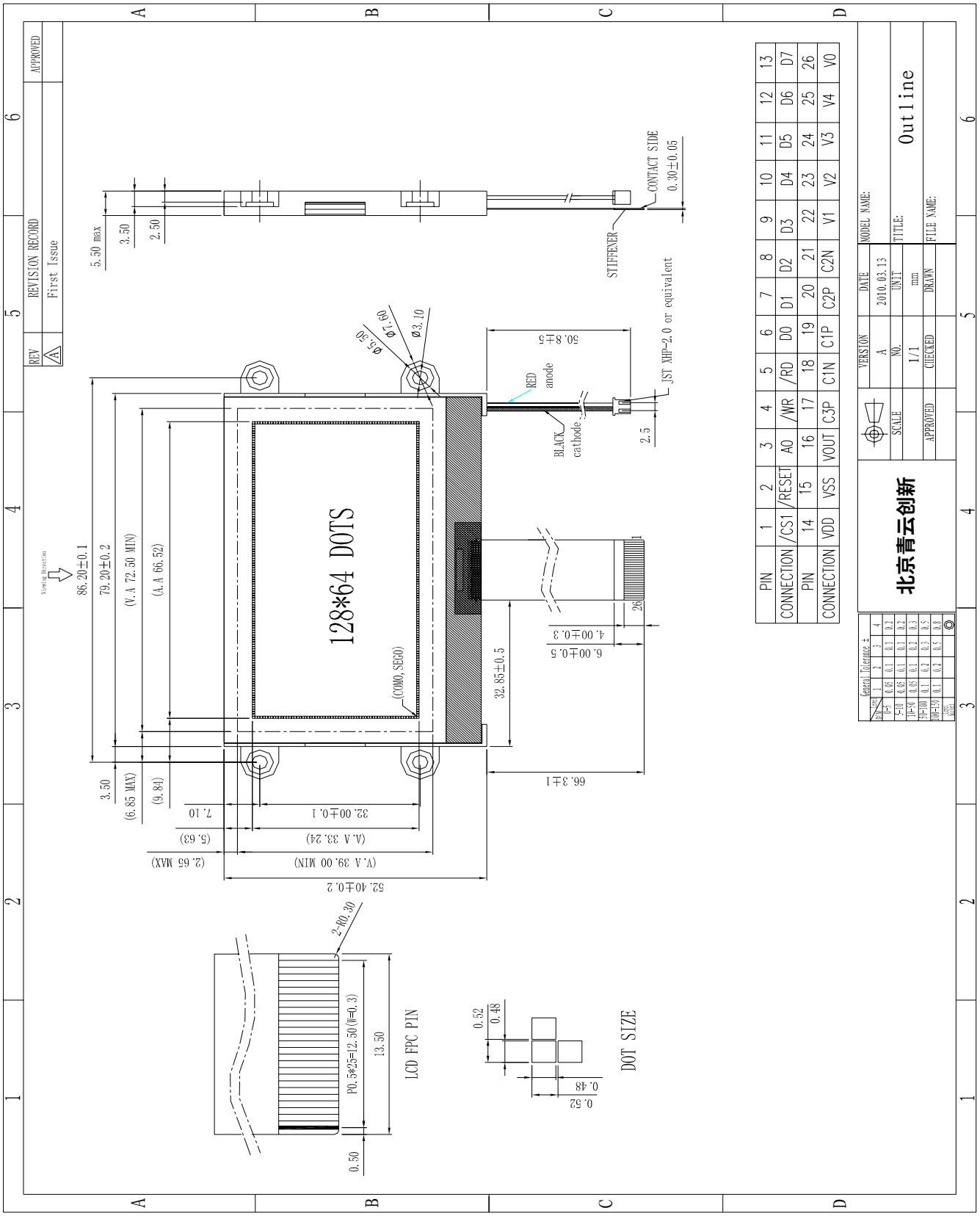
In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- 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	1	2	3	4	5	6	7	8	9	10	11	12	13
CONNECTION	/CS1	/RESET	A0	/WR	/RD	D0	D1	D2	D3	D4	D5	D6	D7
PIN	14	15	16	17	18	19	20	21	22	23	24	25	26
CONNECTION	VDD	VSS	VOUT	C3P	C1N	C1P	C2P	C2N	V1	V2	V3	V4	V0