LONDATECH

Date: 2006.05.12

Specifications for Approval

Customer : _____

Model name : LMC2023A-YTDDON-A0 REV:A

Description : LIQUID CRYSRAL DISPLAY MODULE

DESIGN	CHECK	APPROVED

Customer Approval	☐ **Accept** ☐ **Reject** **Comment:** **Approved by:**

CONTENTS

LCM MODULE NUMBERING SYSTEM

PART NUMBER: LMAx……yB-CDEFGHI-JK

L: LONDA TECHNOLOGY
M: MODULE
A: DISPLAY CONTENTS C--- CHARACTER TYPE
G--- GRAPHIC TYPE
S---SEGMENT TYPE
x……: CHARACTERS Vs. LINES FOR CM
COLUMNS Vs. ROWS FOR GM
SERIALS NUMBER FOR SM
y: DISTRIBUTE ACCORDING TO SIZE
B： VERSION OF PCB
C: LCD TYPE:
Y---YELLOW STN G---GRAY STN B---BLUE STN
F---FSTN T---TN
D: POLARIZER TYPE:
R--- REFLECTIVE T--- TRANSFLECTIVE
M--- TRANSMISSIVE
E: VIEWING TEMPRETURE:
U--- 12:00 D--- 6:00 L--- 9:00 R--- 3:00
F: BACKLIGHT TYPE:
D---BOTTOM LED S---SIDE LED E--- EL C--- CCFL
N---NO BACKLIGHT
G: COLOR OF BACKLIGHT：
Y---YELLOW/GREEN G--- GREEN B--- BLUE
W--- WHITE O--- ORANGE A--- AMBER
H:OPERATING TEMPRETURE:
N--- NORMAL, W--- EXTENDED , X:ESPECIALLY EXTENDED
I: DENOTE DIFFERENT CHARACTER TABLE:
NORMAL ELLIPSIS, T--- TAB , G--- COG
–JK:
FOR CM:
J: IC TYPE: A--- KS0066U B--- SPLC780
K: CHARACTER STOREROOM SEQUENCE NUMBER
FOR GM:
J: BACKLIGHT DRIVER
Y--- WITH N--- WITHOUT
K: DC-DC CONVERTER
Y--- WITH N--- WITHOUT

1. FEATURES

The features of LCD are as follows

* Display mode : STN, Positive, Transflective
* Color : Display dot : Dark Blue
  Background: Yellow-Green
* Display Format : 20 X 2 Characters
* IC : S6A0069 and S6A0065
* Interface Input Data : 4-bit or 8-bit Parallel
* Driving Method : 1/16 Duty, 1/5 Bias
* Viewing Direction : 6 O'clock
* Backlight : LED (Orange)

2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	180(W) x 40(H) X 14.5MAX(T)	mm
Viewing Area	149(W) X 23(H)	mm
Effective Display Area	143.88(W)X 20.40(H)	mm
Character Font	5 X 8 with Cursor	
Character Pitch	7.26(W) X 10.86(H)	mm
Character Size	5.94(W) X 9.54(H)	mm
Dot Pitch	1.20(W) X 1.20(H)	mm
Dot Size	1.14(W) X 1.14(H)	mm

3. ELECTRICAL SPECIFICATIONS

3-1. Absolute Maximum Ratings (Vss=0V)

Item	Symbol	Standard Value			Unit
		Min.	Typ.	Max.	
Supply Voltage For Logic	V_{DD}-V_{SS}	-0	-	+5.5	V
Supply Voltage For LCD Drive	V_{DD}-V_0	-0	-	+5.5	V
Input Voltage	V_{IN}	Vss	-	V_{DD}	V
Operating Temp.	T_{OP}	0	-	50	°C
Storage Temp.	T_{ST}	-20	-	70	°C

Notes : Voltages $VDD \geq V1 \geq V2 \geq V3 \geq V4 \geq V5 \geq V_0$ must always be satisfied.

3. ELECTRICAL SPECIFICATIONS (Continued)

3-2. Electrical Characteristics (Vss=0V)

Item		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage		V_{DD} – V_{SS}	Ta=0~50°C	4.5	5.0	5.5	V
LCD Drive Voltage (Recommended Voltage)		V_{DD} – V_0	Ta=25°C	-	4.5	-	V
Input Voltage	"H" Level	V_{IH}	V_{DD}=5.0V ± 5%	0.8	-	V_{DD}	V
	"L" Level	V_{IL}		0	-	0.2	V
Output Voltage	"H" Level	V_{OH}	V_{DD}=5.0V ± 5%	0.8	-	V_{DD}	V
	"L" Level	V_{OL}		0	-	0.2	V
Current Consumption		I_{DD}	V_{DD} =5.0V ± 5% V_{DD}-V_0=4.5V	-	1.34	3.0	mA

NOTE: 1) Duty Ratio=1/16, Bias Ratio=1/5

2) Measuring in Dots ON-state

3-3. BACKLIGHT

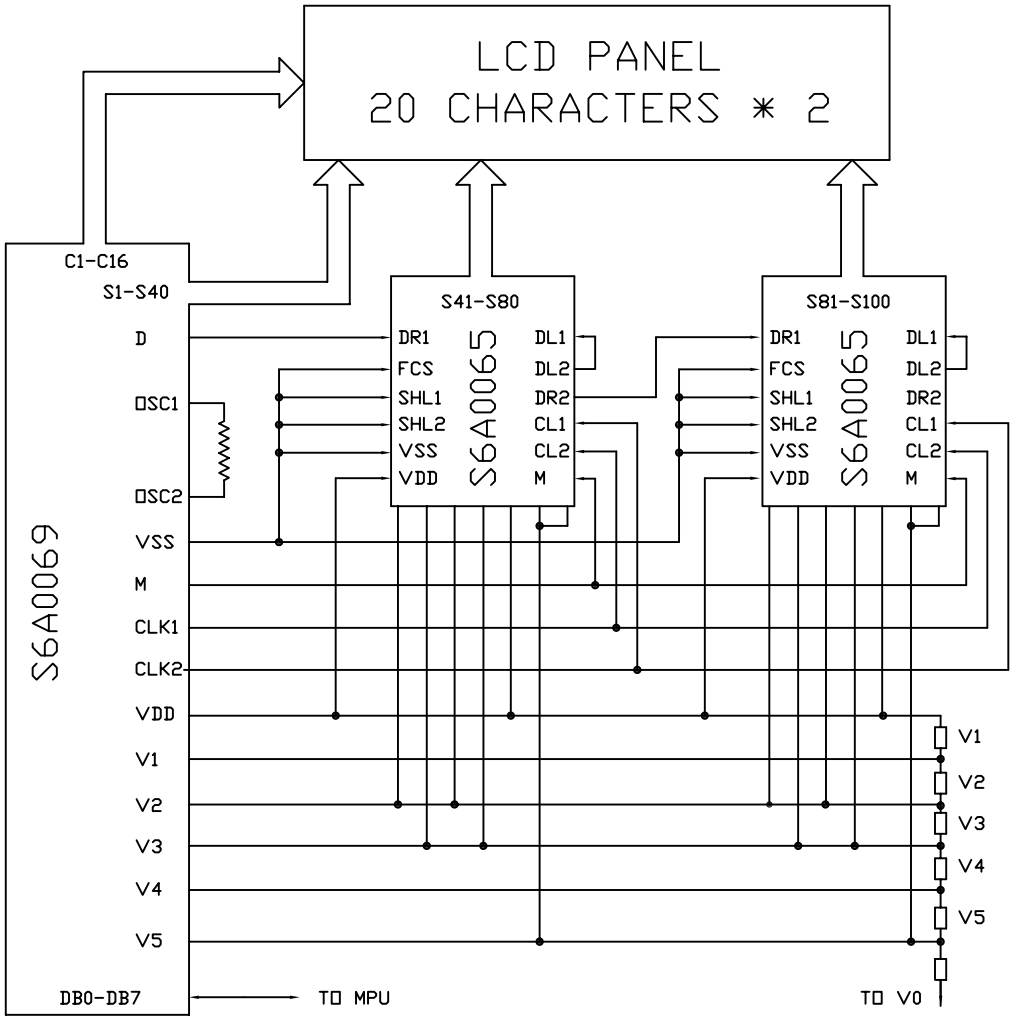
3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max	Unit
Forward Current	IF	Ta= 25℃	-	-	420	mA
Reverse Voltage	VR		-	-	8.0	V
Power Dissipation	PD	Ta= 25℃	-	-	1800	mW

3-3-2. Opto-electronic Characteristics

Item	Symbol	Condition	Min.	Typ.	Max	Unit
Forward Voltage	VF	Ta= 25℃ IF= 420mA	-	5.0	5.2	V
Luminous	-		-	-	-	cd/m²

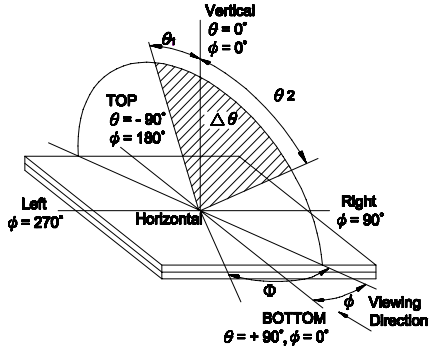
4. BLOCK DIAGRAM AND POWER SUPPLY



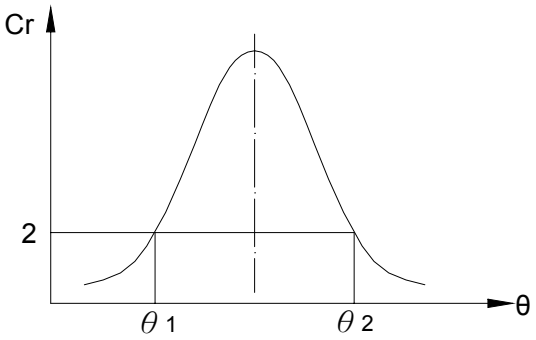
5. ELECTRO – OPTICAL CHARACTERISTICS

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions	Note
Viewing Angle	Θ2 – Θ1	25℃	30	92	-	Deg.	-	1,2
	Φ		80	90	-			
Contrast Ratio	Cr	25℃	2	11.1	11.9	-	Θ=0° Φ=0°	3
Response Time(rise)	Tr	25℃	-	92	250	ms	Θ=0° Φ=0°	4
		0℃	-	950	1150			
Response Time(fall)	Tf	25℃	-	119	250	ms	Θ=0° Φ=0°	4
		0℃	-	950	1150			

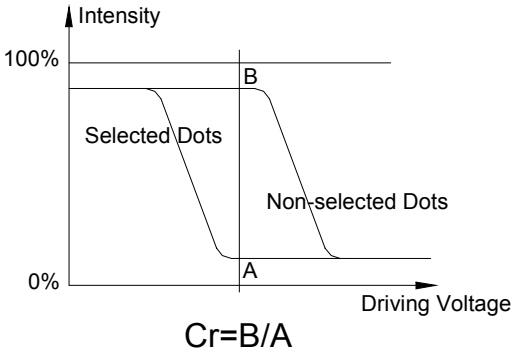
Note1 . Definition of Angle Θ&Φ



Note2. Definition of Viewing Angle Θ1&Θ2

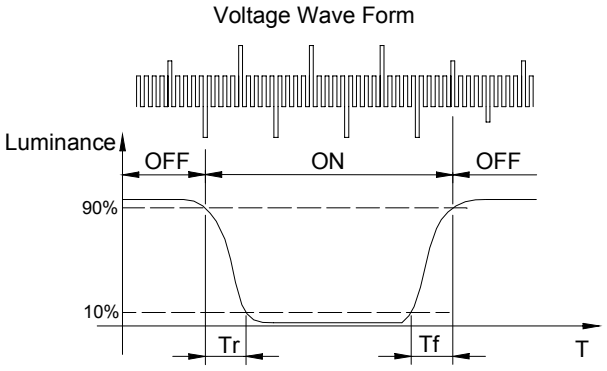


Note3 . Definition of Contrast Cr



Cr=B/A

Note4. Definition of Optical Response



6. TERMINAL PIN FUNCTION

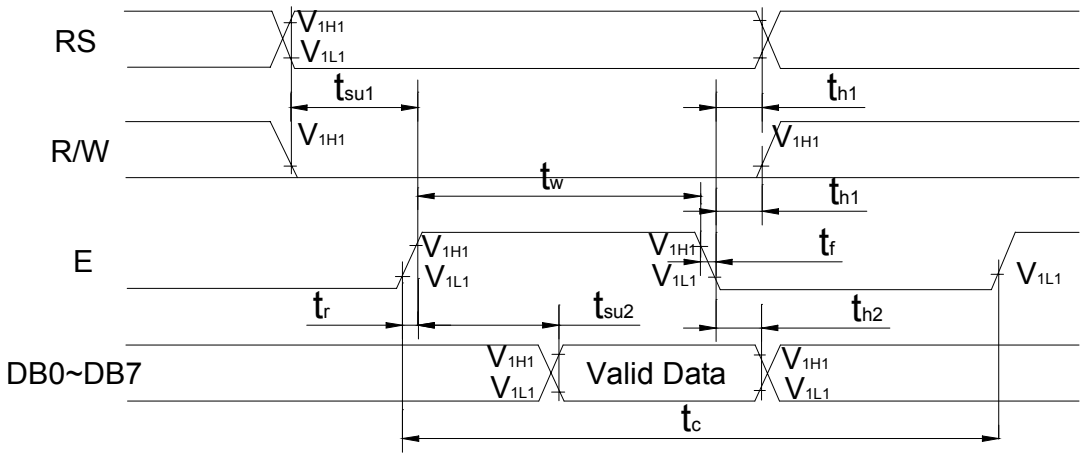
6-1. Interface Pin Function Description

Pin NO.	Symbol	I / O	Functions
1	V_{SS}	Power	GND
2	V_{DD}	Power	Power supply for logic circuit 5.0V
3	V0	Power	Contrast adjustment
4	RS	I	Register select signal
5	R/W	I	Used as read/write selection input when Rw="high" read operation Rw="Low", write operation
6	E	I	Enable signal
7	DB0	I/O	Data bus
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		
15	LED(A)	-	Backlight(+) 5.0V
16	LED(K)	-	Backlight(-)

7.TIMING CHARACTERISTICS

7-1. Write Mode (Writing data from MPU to LCM)

Mode	Symbol	Min.	Typ.	Max.	Unit
E Cycle Time	t_C	500	-	-	ns
E Rise / Fall Time	t_R，t_F	-	-	20	ns
E Pulse Width (High, Low)	t_W	230	-	-	ns
R/W and RS Setup Time	t_{su1}	40	-	-	ns
R/W and RS Hold Time	t_{H1}	10	-	-	ns
Data Setup Time	t_{su2}	80	-	-	ns
Data Hold Time	t_{H1}	10	-	-	ns

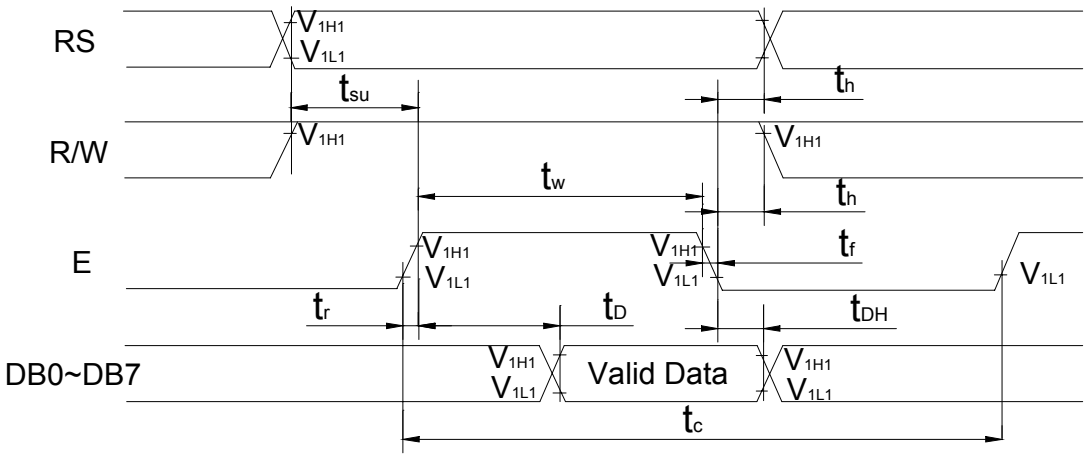


Write Mode Timing Diagram

7.TIMING CHARACTERISTICS (Continued)

7-2. Read Mode (Reading data from MPU to LCM)

Mode	Symbol	Min.	Typ.	Max.	Unit
E Cycle Time	t_C	500	-	-	ns
E Rise / Fall Time	t_R，t_F	-	-	20	ns
E Pulse Width (High, Low)	t_W	230	-	-	ns
R/W and RS Setup Time	t_{su1}	40	-	-	ns
R/W and RS Hold Time	t_{H1}	10	-	-	ns
Data Output Delay Time	t_{su2}	-	-	120	ns
Data Hold Time	t_{H1}	5	-	-	ns



Read Mode Timing Diagram

8.INSTRUCTION SET

8-1. Instruction Table

Function	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execu. Time*(Max.)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear Entire Display	1.53mS
Return Home	0	0	0	0	0	0	0	0	1	*	Return Display Being Shifted to Original Position	1.53mS
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Set Cursor Move Direction And Specifies Shift of Display	39uS
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	D: Display On /Off C: Cursor On/Off B: Cursor Blink/Not	39uS
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	*	*	Move Cursor And Shift Display	39uS
Function Set	0	0	0	0	1	DL	N	F	*	*	Set DL, N, F	39uS
Set CG RAM Address	0	0	0	1	ACG						Set CG RAM Address	39uS
Set DD RAM Address	0	0	1	ADD							Set DD RAM Address	39uS
Read Busy Flag & Address	0	1	BF	AC							BF: Busy Flag Read AC Contents	0uS
Write Data to CG RAM	1	0	WRITE DATA								Write Data to DD RAM or CG RAM	43uS
Read Data From CG/DD RAM	1	1	READ DATA								Read Data From DD RAM or CG RAM	43uS
Remark	I/D = 1 : Increment 0 : Decrement S = 1 : Accompanies Display Shift S/C = 1 : Display Shift 0 : Cursor Move R/L = 1 : Shift right 0 : Shift left DL = 1 : 8 Bits 0 : 4 Bits N = 1 : 2 Line 0 : 1 Line F = 1 : 5 x 10 Dots 0 : 5 x 7 Dots BF = 1 : Internally Operating 0 : Can Accept Instruction										DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : CG RAM Address ADD : DD RAM Address Corresponds to Cursor Address AC : Address Counter used for Both DD and CG RAM Address * No effect (Don't care)	

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

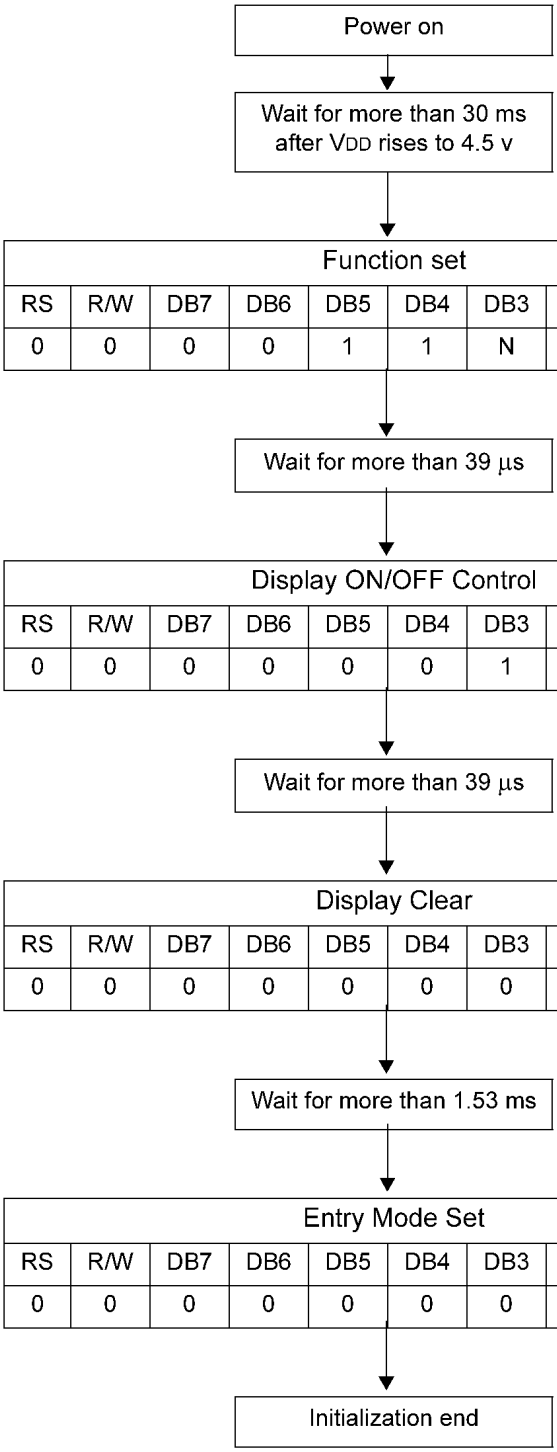
8-2. DDRAM Address

Display position	Column	1	2	3	4	5	---	16	17	18	19	20
DD RAM Address (Hex-Decimal)	1-Line	00H	01H	02H	03H	04H	---	0FH	10H	11H	12H	13H
	2-Line	40H	41H	42H	43H	44H	---	4FH	50H	51H	52H	53H

8.INSTRUCTION SET (Continued)

8-3. Instruction Initialization

8-3-1. 8-bit interface mode



N	0	1-line mode
	1	2-line mode

F	0	display off
	1	display on

D	0	display off
	1	display on

C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

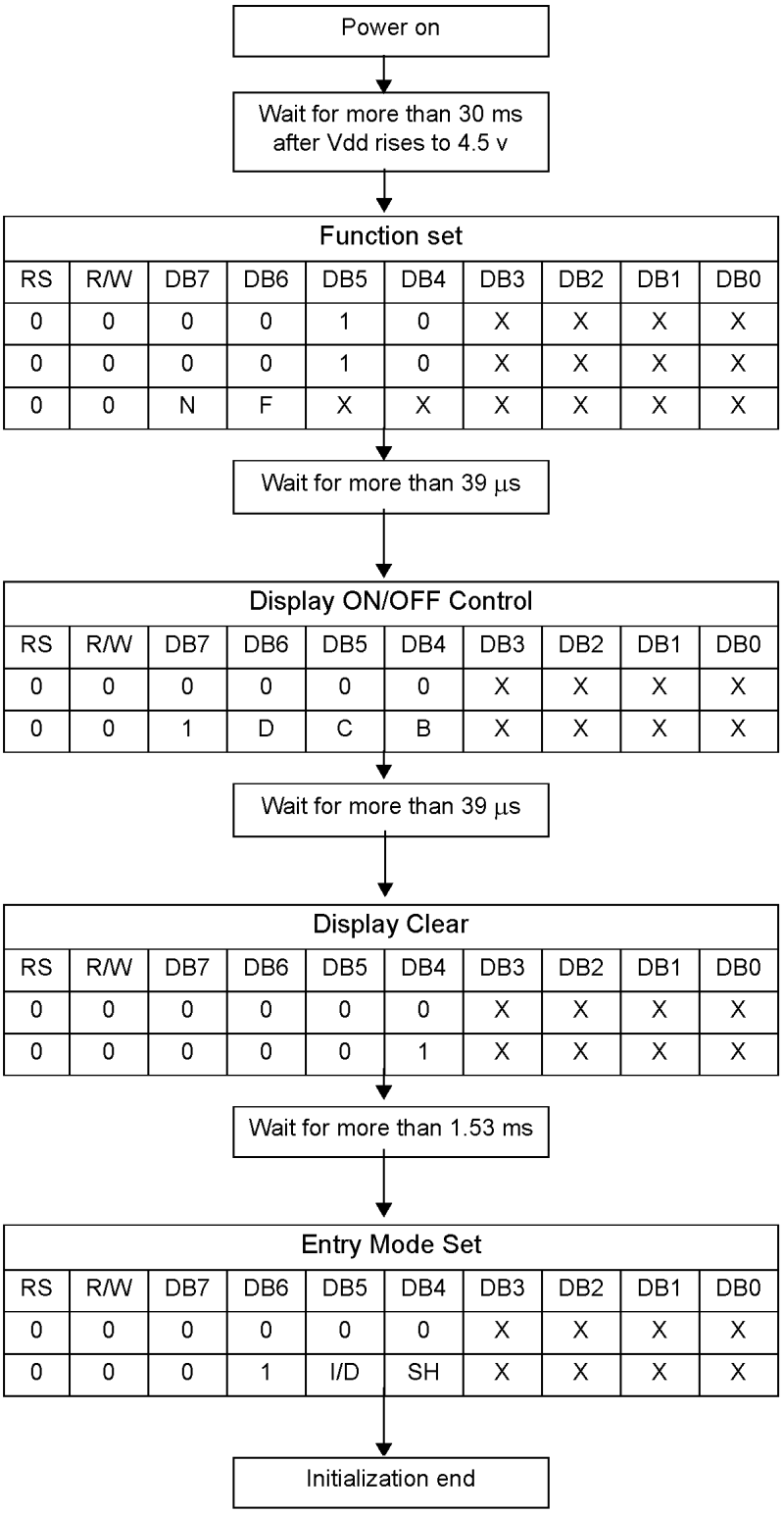
I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

8.INSTRUCTION SET (Continued)

8-3. Instruction Initialization (Continued)

8-3-2. 4-bit interface mode



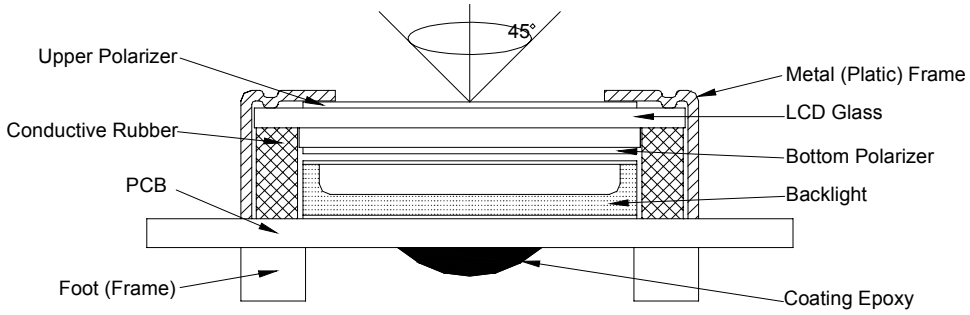
N	0	1-line mode
	1	2-line mode
F	0	display off
	1	display on
D	0	display off
	1	display on
C	0	cursor off
	1	cursor on
B	0	blink off
	1	blink on
I/D	0	decrement mode
	1	increment mode
SH	0	entire shift off
	1	entire shift on

9. FONT TABLE

10. QUALITY SPECIFICATIONS

10 - 1. LCM Appearance and Electric inspection Condition

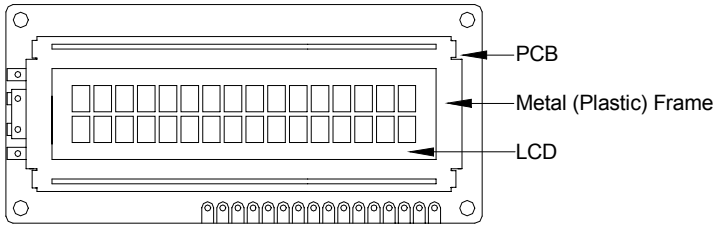
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



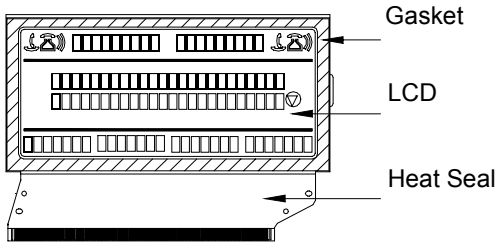
2. View Angle: with in 45°around perpendicular line.

10 - 2. Definition

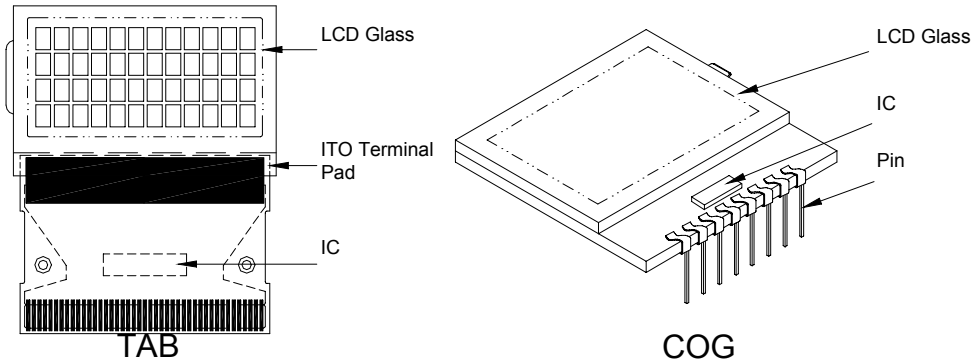
1. COB



2. Heat Seal



3. TAB and COG



10. QUALITY SPECIFICATIONS (Continued)

10-3. Sampling Plan and Acceptance

1. Sampling Plan

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

2. Acceptance

Major defect: AQL = 0.25%

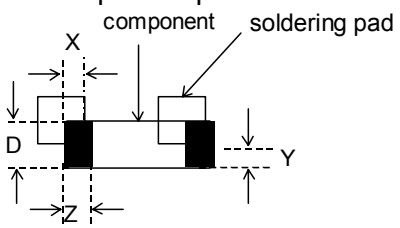
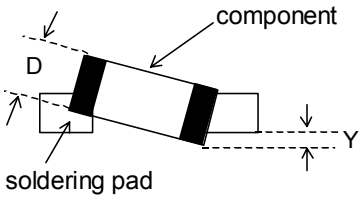
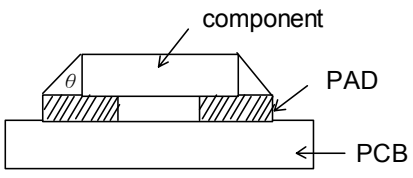
Minor defect: AQL = 0.65%

10-4. 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

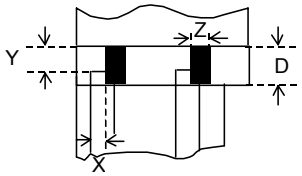
10. QUALITY SECIFICATIONS (Continued)

10-4. Criteria (Continued)

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
		$\Phi \leq 1.0$mm		2
		$1.0 < \Phi \leq 1.5$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
		Φ > 1.0mm	Reject
Minor	Position shift 	Y > 1/3D	Reject
		X > 1/2Z	Reject

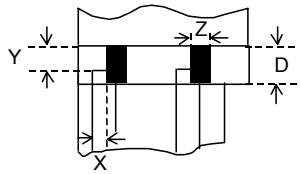
10. QUALITY SPECIFICATIONS (Continued)

10-4. Criteria (Continued)

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 $\Phi = \frac{L+W}{2}$	Φ> 0.5mm	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$0.10mm	Ignore
		0.10< $\Phi \leq$0.15mm	2
		0.15< $\Phi \leq$0.2mm	1
		Φ>0.2mm	0
		The distance between any two spots should be $\geq$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

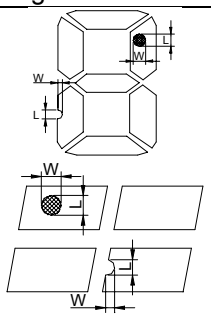
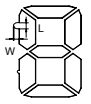
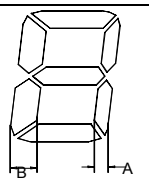
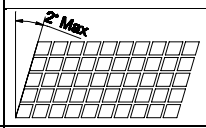
8. Electric Inspection

Defect	Inspection Item	Inspection Standards	
Major	Short		Reject
Major	Open		Reject

10. QUALITY SPECIFICATIONS (Continued)

10-4. Criteria (Continued)

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
			Note	W is more than 1/2 segment width			Reject
				$\Phi = \frac{L + W}{2}$ 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”				

11. RELIABILITY

NO.	Item	Condition	Criterion
1	High Temperature Operating	50℃, 240Hrs	No defect in cosmetic and operational function allowable. Total current Consumption should be below double of initial value.
2	Low Temperature Operating	0℃, 240Hrs	
3	High Humidity	40℃, 90%RH, 96Hrs	
4	High Temperature Storage	70℃, 240Hrs	
5	Low Temperature Storage	-20℃, 240Hrs	
6	Vibration	Random wave 10 ~ 100Hz Acceleration: 2g 2 Hrs per direction(X,Y,Z)	
7	Thermal Shock	0℃ to 25℃ to 50℃ (60Min) (5Min) (60Min) 10Cycles	
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 GOLDENTEK standard products.

2) For restrict products, the test conditions listed as above must be revised.

12. HANDLING PRECAUTIONS

(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
- Trichlorotrifloroethane

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.

12. HANDLING PRECAUTIONS (Continued)

- 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)

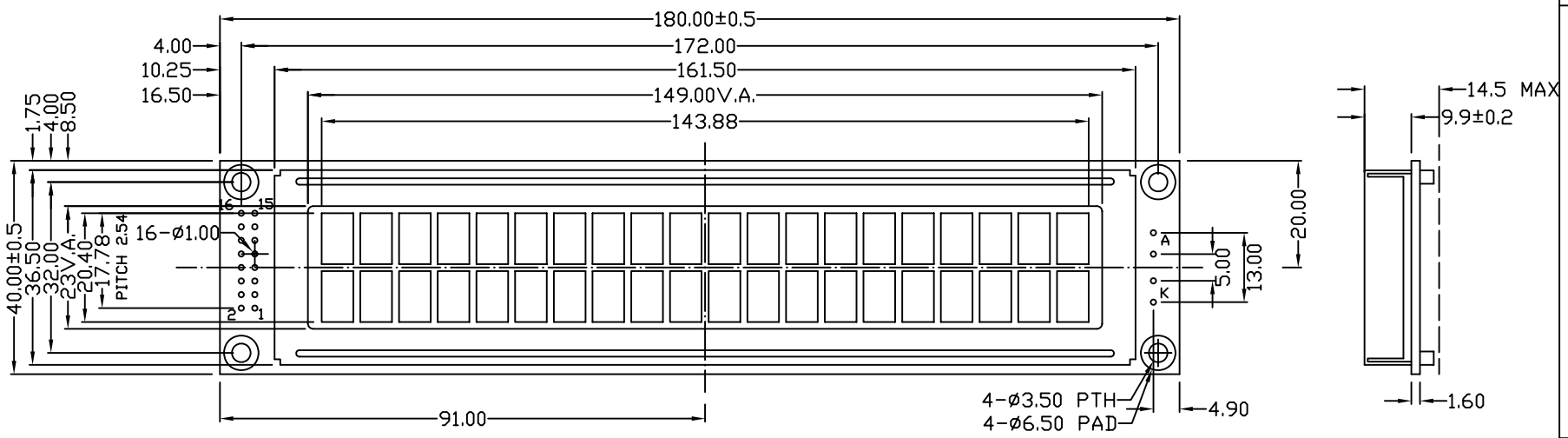
(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.

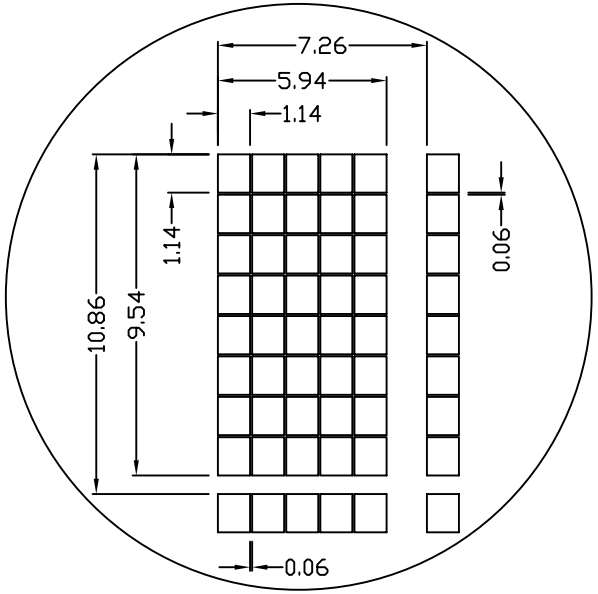
Which should be burned up later.

- 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.

13. Outline Drawing



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VSS	VDD	V0	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	A	K



NOTES:

1. LCD TYPE: STN,YELLOW-GREEN MODE
2. VIEWING ANGLE: 6:00 CLOCK
3. POLARIZER MODE: TRANSFLECTIVE/POSITIVE
4. OPERATING TEMP: 0° C--+50° C
5. STORAGE TEMP: -20° C--+70° C
6. POWER SUPPLY: +5.0V,VLCD: 4.5V
7. BACKLIGHT: LED,ORANGE, 5.0V
8. LCD DRIVE MODE: 1/16 DUTY,1/5 BIAS
9. LCD DRIVER: S6A0069 & S6A0065
10. UNMARKED TOLERANCE: ± 0.2mm