APEX DISPLAY LIMITED

LCD MODULE SPECIFICATION

Model Number : AX07014-01
Product Type : COG, STN
Sample Version: A

APPROVAL SIGNATURE

Customer   : _____

Approved by : _____ (Signature)

Date   : _____

Please return one copy with your official approval

EEDTL SIGNATURES

Department	Name	Signature
Prepared by (DE)		
Checked by (QA)		
Confirmed by (DE)		
Approved by (DE Mgr.)		

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Revisions

Rev.	Date	Page	Revise	Prepared by
A00	Sep 17, 2007	-	First issue	ALAN

Table of Contents   Page

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1. Product Features

1.1 Introduction

This is a 128*64 dots STN Display with COG technology. It consists of 1.1mm Glass substrates.

1.2 General Features

Parameter	Value	Unit
LCM Type	COG	-
Storage Temperature	-30℃~+80℃	℃
Operating Temperature	-20℃~+70℃	℃
LCD Type	STN	-
LCD Mode	Positive , YellowGreen,Transflective	-
Viewing Direction	6	O'clock
LCD Operating Voltage	9.3	V
VDD	3.0	V
Driving Scheme	1/65 Duty Cycle 1/9 Bias	-
IC Driver	SPLC501C	-
Interface/Date Transfer	Parallel interface 8080 Series	-
Backlight	YellowGreen (VF=4.2V&IF=120mA)	-
Display Resolution	128*64	dots

2. Mechanical Specification

2.1 General Specification

Parameter	Value	Unit
Module Size	93.70mm(L)*118.39mm(W) (including FPC)	mm
Viewing Area(V.A.)	70.70mm(L)*38.80mm(W)	mm
Active Area(A.A.)	66.52mm(L)*33.24mm(W)	mm
Number of dots	128*64	dots
Dot Size(W*H)	0.48mm(L)*0.48mm(W)	mm
Dot Pitch(W*H)	0.52mm(L)*0.52mm(W)	mm
General Tolerance	Refer to Counter or Drawing	mm

2.2 Outline Dimension (Counter Drawing)

REV	DESCRIPTION:	DATE
A00	First issue	Jul-04-2007

PIN CONNECTION

NO	SYMBOL
1	/CS1
2	/RESET
3	A0
4	/WR
5	/RD
6	D0
7	D1
8	D2
9	D3
10	D4
11	D5
12	D6(SCL)
13	D7(SI)
14	VDD
15	VSS
16	VOUT
17	CAP3-
18	CAP1+
19	CAP1-
20	CAP2-
21	CAP2+
22	V1
23	V2
24	V3
25	V4
26	V5

PIN CONNECTION

REFLECTOR

Black tape

MAX.2.0
MIN.0.4

4.0±0.5
6.0±0.5

CIRCUIT DESIGN (LED 2×8=16 DICES)
COLOR : YELLOW-GREEN
VF=4.2±0.2V@IF=120mA

A
K

DOTS SIZE
0.62 / 0.58
0.58 / 0.62

2.85MAX
1.1±0.1
SILICONE
TAPE (TAP-EN50001)
TAPE(TAP-EN50001)
SILICONE
FPC
CONTACT SIDE
STIFFENER
A—A
0.3±0.07

5.30 / 5.20
2.5
2.8
4.0
13.0
0.7
FPC
CONTACT SIDE
STIFFENER
0.3±0.07

Viewing direction

51.3
(7.10)
(3.1)
(6.2)
(5.9)
32.0±0.2
1.0
55.0±5
BLACK K
RED A
白膜

93.7
86.2
79.20
77.8±0.2
70.70
66.52
DOTS 128X64
31.5±0.5
67.09±0.5

2.0
3.5

A0 OK

33.24
38.80
V.A40.5MIN
51.6±0.2
52.60
(3.8)
(3.5)
(4.2)
(0.25)
(4.1)
白膜
白膜

4.7
4-Ø5.5
4-Ø3.1
4-R3.75

5.2
5.3

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MODEL No. AX07014-01

Drw:ALAN
Chk:Peter Li
Apv:Vincent

Unit: mm

DESCRIPTION: C / D

GENERAL TOL: ±0.3

DO NOT SCALE THIS DRAWING.

SPECIFICATION:
1. Display Mode :STN/Positive/Yellow-Green/Transflective
2. Drive Condition :1/65 Duty,1/9 Bias,Vop=9.3V , Vdd:3.0V
3. Viewing angle: 6 O'clock
4. Operating temp. : -20~70°
   Storage temp. : -30~80°
5. Using IC : SPLC501C   8080 Interface Series
6. Backlight color: Yellow-green
7. Dimensions with mark "*"are important ,with mark"O"are referenced.

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3. Electrical Specification

3.1 Maximum Absolute Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Supply Logic voltage	VDD	-0.3	-	3.3	V	Ta=25°C, Vss=0V	
Operation Temperature	Top	-20	-	70	°C	-,	-
Storage Temperature	Tst	-30	-	80	°C	-	-

3.2 Electrical Specification (Ta=25°C)

Item	Symbol	Min	Typ	Max	Unit	Conditions	Note
IC Supply voltage	V_{DD}	2.8	3.0	3.3	V	Vss=0V	-
LCD driving voltage	V_{LCD}	9.1	9.3	9.5	V	Vss=0V	-
Input voltage	V_{IH}	$0.8 V_{DD}$	-	V_{DD}	V	DB0~DB7	-
	V_{IL}	Vss	-	$0.2V_{DD}$	V		
Output voltage	V_{OH}	$0.8 V_{DD}$	-	V_{DD}	V	DB0~DB7	-
	V_{OL}	Vss	-	$0.2V_{DD}$	V		
Supply current	I_{DD}	-	-	1.5	mA	V_{DD}	(1)

Note (1): I_{DD} is measured under the "chess pattern" display .

3.3 Timing Characteristics (IC driver : SPLC501C)

System Bus Read/Write Characteristics (For the 8080 Series MPU)
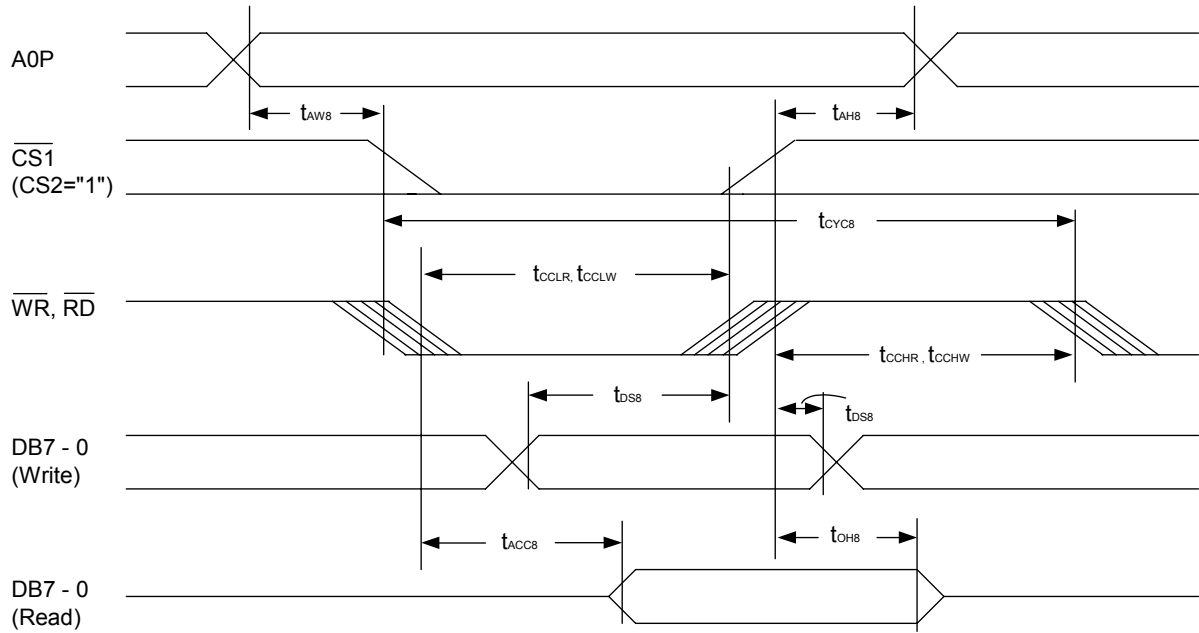
(VDD = 2.7V to 4.5V, T_A = 25℃)

Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Address hold time	A0P	t_{AH8}		0	-	ns
Address setup time		t_{AW8}		0	-	ns
System cycle time	A0P	t_{CYC8}		300	-	ns
Control L pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCLW}		60	-	ns
Control L pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCLR}		120	-	ns
Control H pulse width ($\overline{WR}$)	$\overline{WR}$	t_{CCHW}		60	-	ns
Control H pulse width ($\overline{RD}$)	$\overline{RD}$	t_{CCHR}		60	-	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

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr +tf) ≦ (t_{CYC6} – t_{EWLW} – t_{EWHW}) for (tr + tf) ≦ (t_{CYC6} – t_{EWLR} – t_{EWHR}) are specified.

*2 All timing is specified using 20% and 80% of V_{DD} as the reference.

*3 t_{EWLW} and t_{EWLR} are specified as the overlap between CS1 being "L" (CS2 = "H") and E.

3.4 Interface Pin Description

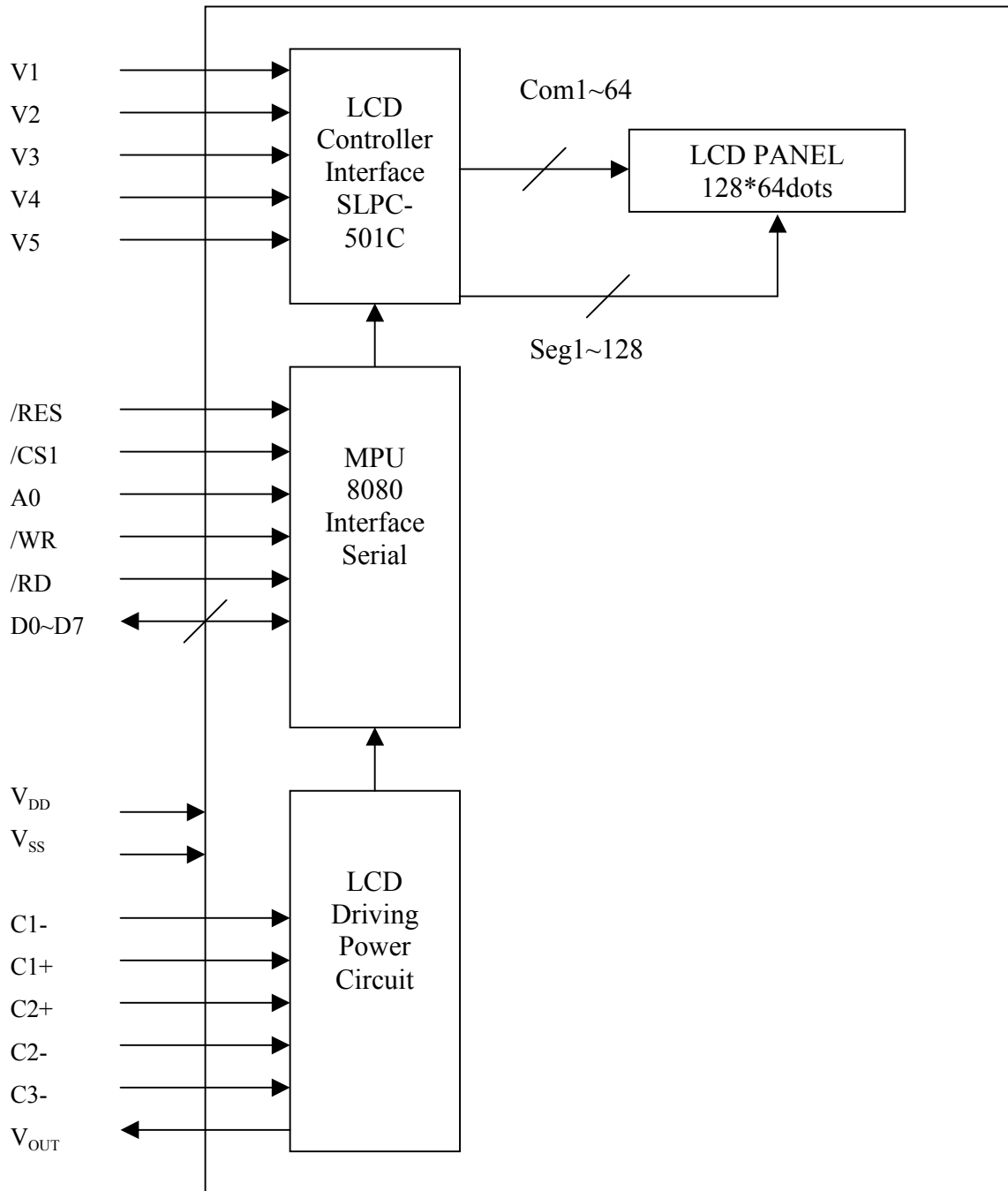| Pin no.	Symbol	Function
1	/CS1	This is the chip select signal. When /CS1 = "L" and CS2 = "H", then the chip select becomes active, and data/command I/O is enabled.
2	/RESET	When /RES is set to "L," the settings are initialized. The reset operation is performed by the /RES signal level.
3	A0	This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command. A0 = "H": Indicates that D0 to D7 are display data. A0 = "L": Indicates that D0 to D7 are control data.
4	/WR	When connected to an 8080 MPU, this s LOW active. This terminal connects to the MPU /WR signal.The signals on the data bus are latched at the rising edge of the /WR signal. When connected to a 6800 Series MPU, this is the read/write control signal input terminal. When /WR = "H": Read; When /WR = "L": Write.
5	/RD	• When connected to an 8080 MPU, this is active LOW. This pin is connected to the /RD signal of the 8080 MPU, and the SPLC501C data bus is in an output status when this signal is "L". • When connected to a 6800 Series MPU, this is active HIGH. This is the 6800 Series MPU enable clock input terminal.
6 ~ 13	D5 to D0 D6(SCL) D7(SI)	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface is selected (P/S = "L") : D7: serial data input (SI); D6: the serial clock input (SCL). D0 to D5 are set to high impedance. When the chip select is not active, D0 to D7 are set to high impedance.
14	V_{DD}	Shared with the MPU power supply terminal V_{CC}.
15	V_{SS}	This is a 0V terminal connected to the system GND.
16	V_{OUT}	DC/DC voltage converter. Connect a capacitor between this terminal and V_{SS}.
17	C3-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1+ terminal.
18	C1+	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1- terminal.
19	C1-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1+ terminal.
20	C2-	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2+ terminal.
21	C2+	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2- terminal.

22	V1	This is a multi-level power supply for the liquid crystal drive. The voltage Supply applied is determined by the liquid crystal cell, and is changed through the use of a resistive voltage divided or through changing the impedance using an op. amp.
23	V2	Voltage levels are determined based on V_{DD}, and must maintain the relative magnitudes: V_{DD} (= V0) $\geqslant$ V1 $\geqslant$ V2 $\geqslant$ V3 $\geqslant$ V4 $\geqslant$ V5
24	V3	When the power supply turns ON, the internal power supply circuits produce the V1 to V4 voltages shown below. The voltage settings are selected using the LCD bias set command.
25	V4	
26	V5	

	SPLC501C
V_1	1/9 V_5
V_2	2/9 V_5
V_3	7/9 V_5
V_4	8/9 V_5

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3.5 Block Diagram

V1 →
V2 →
V3 →
V4 →
V5 →
LCD Controller Interface SLPC-501C

Com1~64 → **LCD PANEL 128*64dots**

Seg1~128

/RES →
/CS1 →
A0 →
/WR →
/RD →
D0~D7 ↔
MPU 8080 Interface Serial

V$_{DD}$ →
V$_{SS}$ →
C1- →
C1+ →
C2+ →
C2- →
C3- →
V$_{OUT}$ ←
LCD Driving Power Circuit

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4 Electro-optical Characteristics

4.1 Optical Characteristics

Item		Symbol	Temp (℃)	Min.	Typ.	Max.	Unit	Conditions
Operating Voltage		V_{LCD}	25	9.1	9.3	9.5	V	V0-Vss
Response Time		T_R	25	-	140	200	ms	θ=0°, φ=0°
		T_F	25	-	140	200	ms	θ=0°, φ=0°
Contrast Ratio		CR	25	-	6	8	Degree	θ=30°, φ=0°
Viewing Angle	Top direction	$θ_T$	25	35	-	-	Degree	Cr≥2.0
	Bottom direction	$θ_B$	25	45	-	-	Degree	
	Left direction	$Φ_L$	25	35	-	-	Degree	Cr≥2.0
	Right direction	$Φ_R$	25	35	-	-	Degree	
Visual Angle Direction Priority		-	-	-	6:00	-	-	-
Frame Frequency		f_{FR}	-	-	75	-	Hz	-

Note: Common operation for measurement

    (1) Frequency: f_{FR} = 75Hz

    (2) Duty and Bias: 1/65 duty, 1/9 Bias;   Mode: Positive, Transflective

    (3) Supply voltage: V_{LCD}=9.3V   Voltage to be supplied to LCD giving maximum contrast ratio
                                                at all-on and all-off.

4.2 Definitions of Optical Characteristics

4.2.1 Definition of Viewing Angle

Φ、θ definition

(Visual angle direction)

z

θ

y

LCD

Φ

x

(6-o'clock visual angle direction)
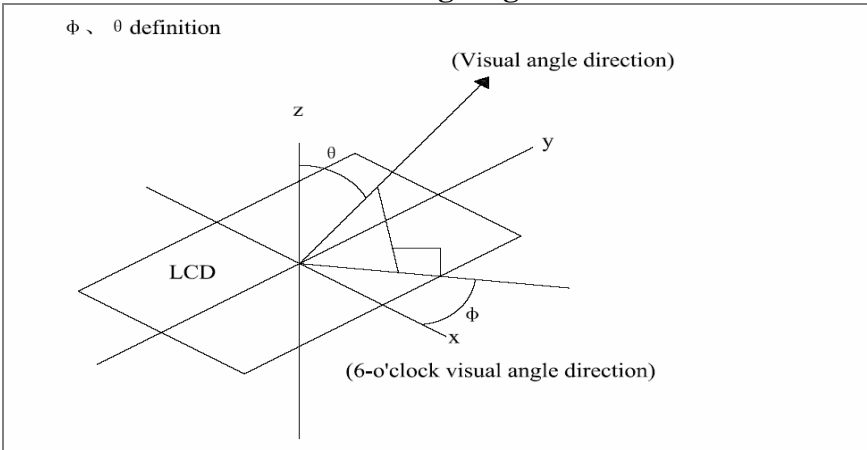
Notes: θ: Angle between Viewer Direction and Normal. (-90° ≤θ≤90°)

Φ: Angle between Projection of Viewer Direction to X-Y plane and Y axis. (0° ≤Φ≤360°)

Top (12 o'clock)

θ_T

θ_B

0^0

Φ_L Φ_R

(9 o'clock) Left   Right (3 o'clock)
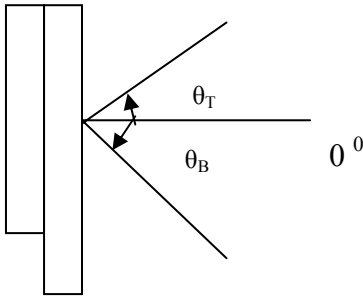
Bottom(6 o'clock)
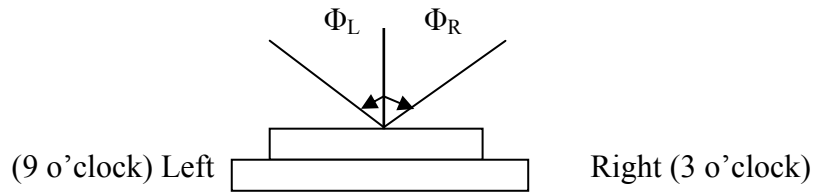
4.2.2 Definition of Response time
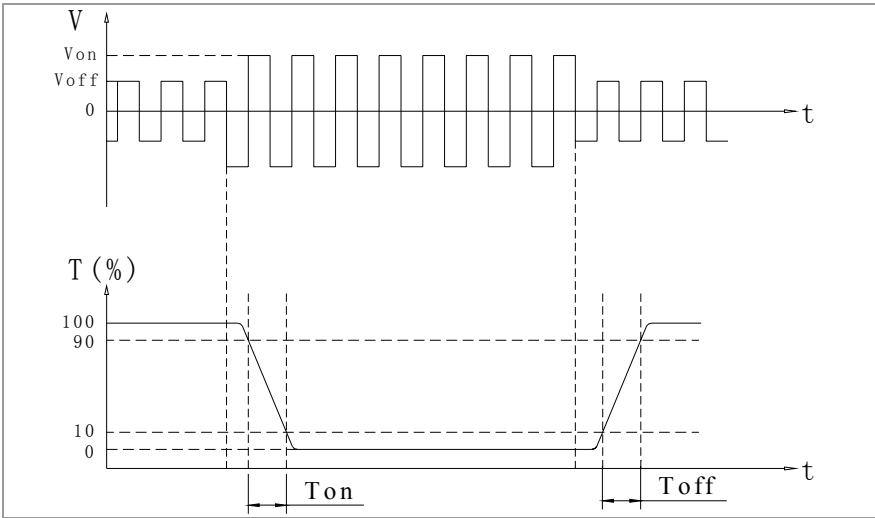
Note: For positive mode LCD, Ton= Rise Time, Toff= Decay Time
For negative mode LCD, Ton= Decay Time, Toff= Rise Time

4.2.3 Definition of Contrast Ratio

Positive mode: n = 1
Negative mode: n = -1

$$\text{Contrast Ratio} = \left\{ \frac{\text{Non-selected segment intensity}}{\text{Selected segment intensity}} \right\}^{n}$$

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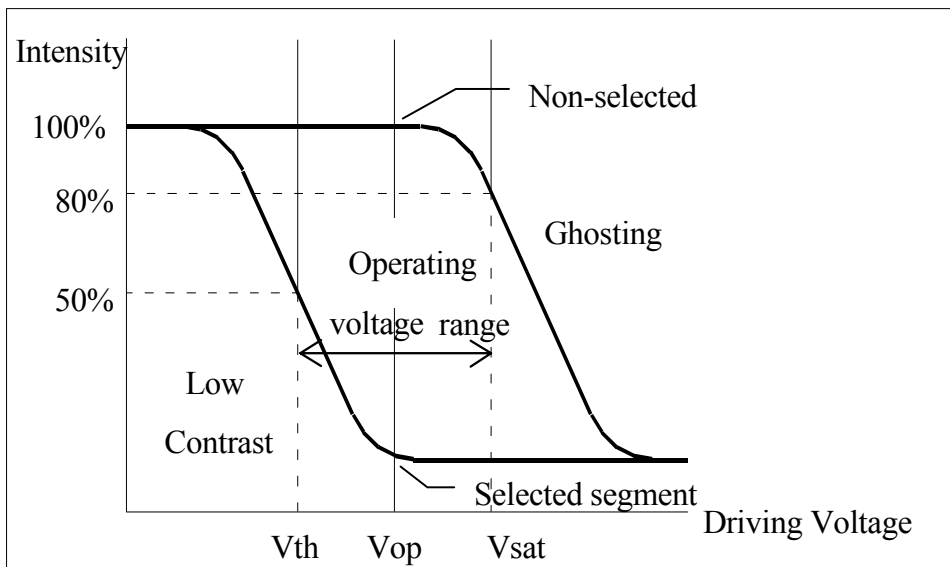
4.3 Measurement Equipment

4.3.1   Brightness and chromaticity Measurement Equipment : TOPCON BM-7

LCM Module

350MM

BM-7

Brightness Gauge
Spot Size: 1 Deg
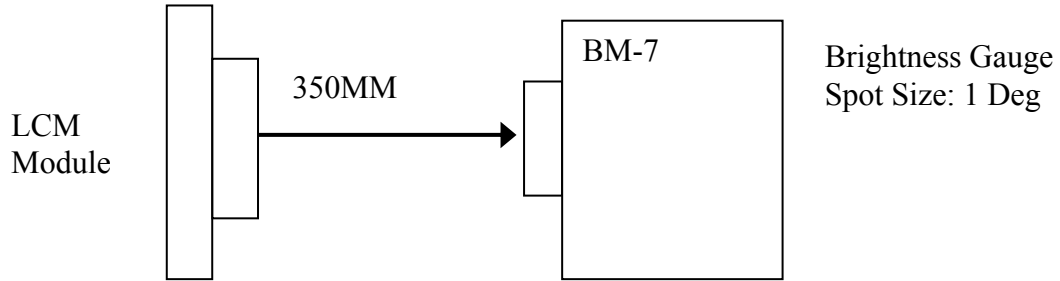
4.3.2   Optical Measurement System: LCD 5100

Measurement condition
1)Ambient Temperature: Ta=25 degree Celsius

Reflcctive Mode   Transmissive Mode

光源

LCD 5100   LCD 5100

20

TOP   TOP

Bottom   Bottom

LCD   LCD

Light

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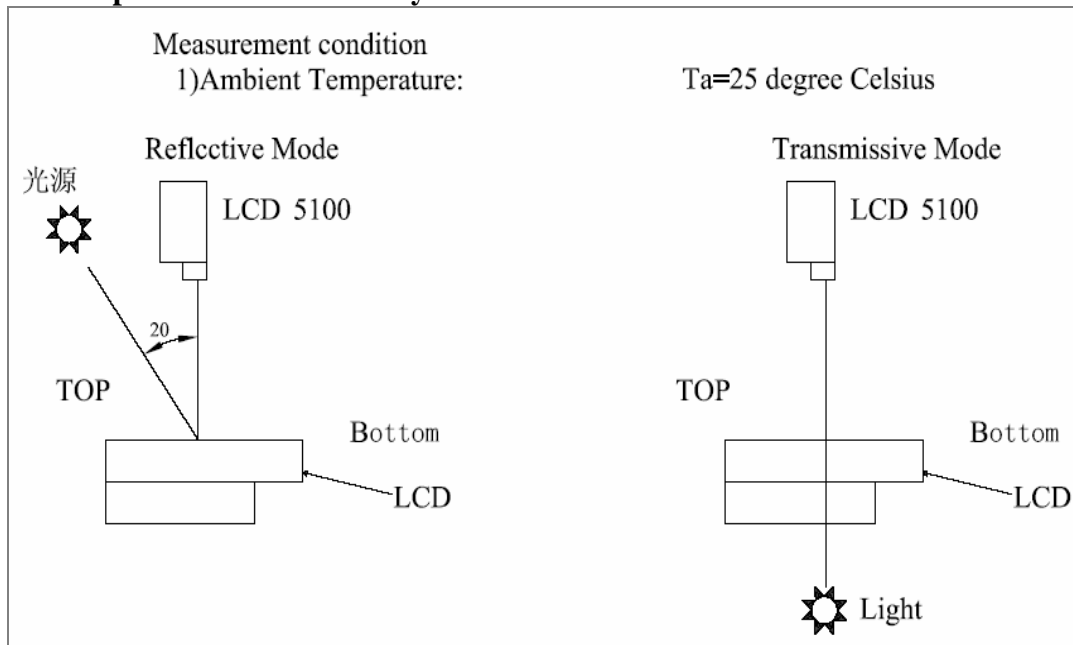
5. Quality Specifications

5.1 Condition for product appearance inspection

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps.
Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and
inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.

Fluorescent
Lamps

30cm min   100cm min

45°   45°

LCM
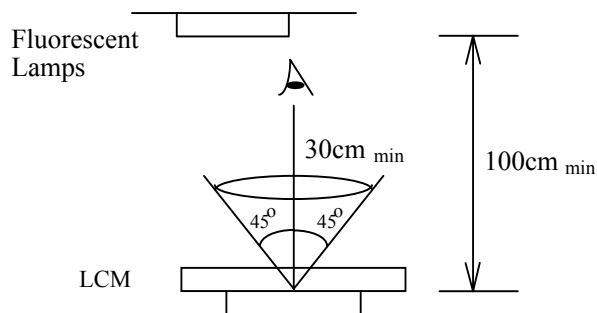
Definition of zone:
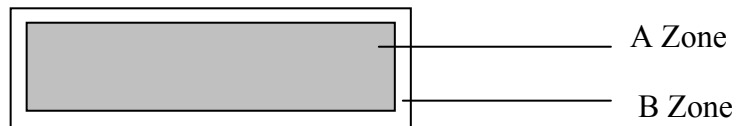
A Zone

B Zone

A Zone: Active display area (minimum viewing area).
B Zone: Non-active display area (outside viewing area).

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5.2 Inspection Standard

AQL inspection standard
Sampling method: MIL-STD-105E, Level II, single sampling
Defect classification :
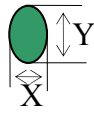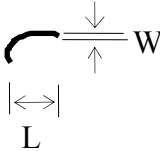
Classify	Item	Note	AQL
Major	Short or open circuit		0.65
	LC leakage		
	Flickering	1	
	No display		
	Wrong viewing direction		
	Contrast defect (dim, ghost)	2	
	Wrong or missing component	11	
Minor	Background color deviation	2	1.0
	Black spot and dust	3	
	Line defect, Scratch	4	
	Rainbow	5	
	Chip	6	
	Pin hole	7	
	Back- light	8	
	Protruded glass	9	
	FPC Position	10	
	Polarizer bubble and foreign material	3	
	Cross talk	Refer to limited sample	

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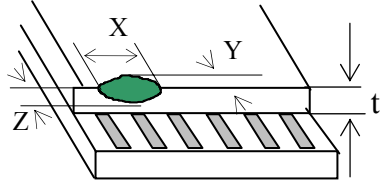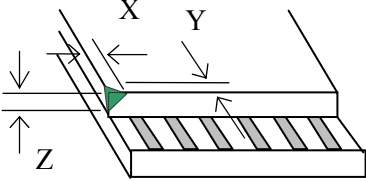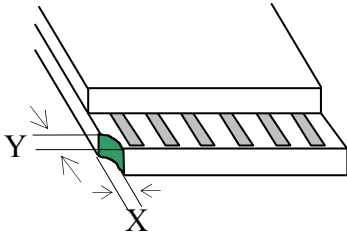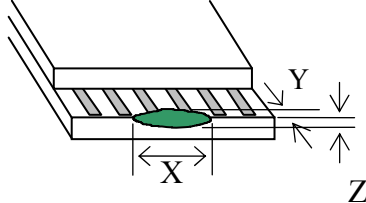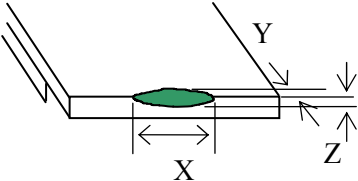
No.	Item	Criterion
1	Short or open circuit	Not allowed
	LC leakage	
	Flickering	
	No display	
	Wrong viewing direction	
	Wrong Back-light	
2	Contrast defect	Refer to approval sample
	Background color deviation	

3 — Point defect, Black spot, dust (including Polarizer)

$\phi = (X+Y)/2$

Point Size	Acceptable Qty.
$\phi \leq 0.10$	Disregard
$0.10 < \phi \leq 0.20$	2
$0.20 < \phi \leq 0.25$	1
$\phi > 0.25$	0

Unit：mm

4 — Line defect, Scratch

Line		Acceptable Qty.
L	W	
---	$0.015 \geq W$	Disregard
$3.0 \geq L$	$0.03 \geq W$	2
$2.0 \geq L$	$0.05 \geq W$	
$1.0 \geq L$	$0.1 > W$	1
---	$0.05 < W$	Applied as point defect

Unit: mm

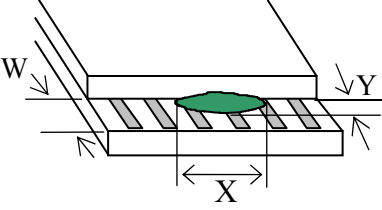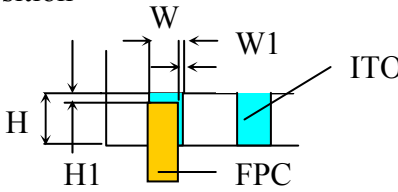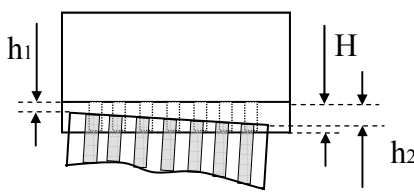| 5 | Rainbow | Not more than two colors change across the viewing area. |
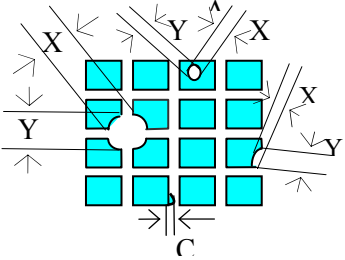
(Continued)

No	Item	Criterion
6	Chip	(see diagrams)

Remark:
X: Notch in X direction
Y: Notch in Y direction
Z: Notch in Z direction
t: Glass thickness
a: LCD length
W: Terminal Width
F: Seal width

Acceptable criterion

X	Y	Z
≤5mm	Not reach to F/3	≤t/2

Acceptable criterion

X	Y	Z
≤3mm	Not reach to F/3	≤t

Acceptable criterion

X	Y	Z
≤3mm shall not reach to ITO	≤2mm	≤t

Acceptable criterion

X	Y	Z
Disregard	≤0.2mm	≤t

Acceptable criterion

X	Y	Z
≤a/10	Not reach to F/3	≤t/3

(Continued)

No.	Item	Criterion
7	Dot-matrix pattern $\phi = (X+Y)/2$	Pin hole C: Shall not touch other dot(s). 	Size	Acceptable Qty.	 	$\phi < 0.1$	Disregard	 	$0.10 \leq \phi \leq 0.20$	1	 	$\phi > 0.20$	0	
8	Back-light	(1) The color of backlight should correspond its specification. (2) Not allow flickering.
9	Protruded W: Terminal width	 Acceptable criteria: $Y \leq 0.4$
10	FPC	Position $W1 \leq 1/3W$ $H1 \leq 1/3H$ Acceptable: $|h2 - h1| \leq 1/8H$

11	Total no. of acceptable Defect	A. Zone
		   Maximum 2 minor non-conformities per one unit.
		   Defect distance: each point to be separated over 5mm
		 B. Zone
		   It is acceptable when it is no trouble for quality and
		   assembly in customer's end product.

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5.3 Reliability Test

Test Item	Conditions		Criteria
	Temperature	**Time (hrs)**	
High temp. Storage	+80°C	240	No such change as to obstruct image function and appearance, LCM is operational after test
High temp. Operating	+70°C	240	
Low temp. Storage	-30°C	240	
Low temp. Operating	-20°C	240	
High Temperature &High Humidity Storage	40°C/ 90%RH	240	
Thermal shock , Storage	-20°C ← 25°C →+60°C (30 min ← 3 min → 30min)	10cycles	
ESD test <Electro-Static Discharge>	Contact Discharge: ±4KV; Air Discharge: ±8KV	/	When turning on again, No abnormalities in functions

Note: Recovery time after reliability test is defined as 4 hours minimum.

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6.Caution and Handling Precaution

6.1 Caution for Safety

6.1.1 Disassembling
Do not disassembling the panels.
6.1.2 Breakage of LCD panel
Do not permit this material to contact the skin, if glass of LCD panel is broken.
6.1.3 Glass of LCD panel
Be careful with chips of glass that may cause injuring fingers or skin, when the glass is broken , chips of the glass may be spread.

6.2 Handling Precautions

LCM is assembled and adjusted with a high precision, please pay attention to the following items when handling:
6.2.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
6.2.2 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
6.2.3 The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichloroacetone, do not use water, ketone or aromatics and never scrub hard.
6.2.4 Do not attempt to disassemble the LCD Module.
6.2.5 If the logic circuit power is off, do not apply the input signals.
6.2.6 When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6.2.7 Do not apply excessive force to the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.

6.3 Electro-Static Discharge Control

Since this module uses a COMS-LSI, the same careful attention should be paid:
6.3.1 Grounding
In order to prevent destruction of the elements by static electricity, be careful to maintain an optimize work environment. Person handling LCD module should be grounded with wrist band. Tooling like soldering iron and screwdrivers and working benches should be grounded. Grounded electro-conductive mats are recommended to be covered on the surface of working benches. Using ionizer(an antistatic blower) is recommended at working area in order to reduce electro-static voltage.
6.3.2 COMS-LSI is used for the module circuit, therefore, operators should be grounded whenever he/she comes into contact with the module.
6.3.3 Do not touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
6.3.4 Do not touch the connection terminals of the display with bare hand, it will cause disconnection or defective insulation of terminals.
6.3.5 The modules should be kept in anti-static bags or other containers resistant to static for storage.

6.4 Precaution for Operation

    6.4.1 Viewing angle varies with the change of liquid crystal driving voltage; Adjust voltage to show the best contrast.

    6.4.2 Driving voltage should be kept within specified range, excess voltage will shorten display life.

    6.4.3 Respondse time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It can be recovered when it returns to the specified temperature range.

6.5 Storage Precautions

    6.5.1 Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.

    6.5.2 For long-term storage at 20±5°C is required, the relative humidity should be kept below 75%RH, and avoid direct sunlight.

6.6 Limited Warranty

APEX LCDs and modules are not consumer products, but may be incorporated by APEX's customers into consumer products or components. Therefore, APEX does not warrant that its LCDs and components are fit for any such particular purpose.

    6.6.1 APEX warrants this product warranty period is one year from its original purchase by customer.

    6.6.2 If this product fail to operate under normal use and service during the warranty period , the liability of APEX is limited to repair or replacement on the terms set forth below. APEX will not be Responsible for any subsequent or consequential events, injury, or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between APEX and the customer, APEX will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with APEX GENERAL LCD INSPECTION STANDARD. (Copies available on request)

    6.6.3 No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.

    6.6.4 In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.