

LCD Module Technical Specification

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Final Revision

Type No. **TVL-55682D101U-LW-I-AAN**

Customer :

Customer's Product No. :

OPTREX CORPORATION

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APPROVED

By _____

Signature :

Date :

Please return this specification within two month with your signature.
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as having been accepted.

1. General Descriptions

1.1 Introduction

The TVL-55682D101U-LW-I-AAN is a Color Active Matrix Thin Film Transistor (TFT) Liquid Crystal Display (LCD) module, which uses amorphous Silicon TFT as a switching device. It is composed of a TFT LCD panel, a timing controller, voltage reference, common voltage, column driver, and row driver circuit. This TFT LCD has a 10.1-inch (diagonally measured) active display area with WSVGA resolution (1,024 vertical by 600 horizontal pixel array).

1.2 Features

- 10.1" TFT LCD Panel
- LED Light-bar Backlight System
- Supports WSVGA (V:1,024 lines, H:600 pixels) Resolution
- Compatible with RoHS Standard

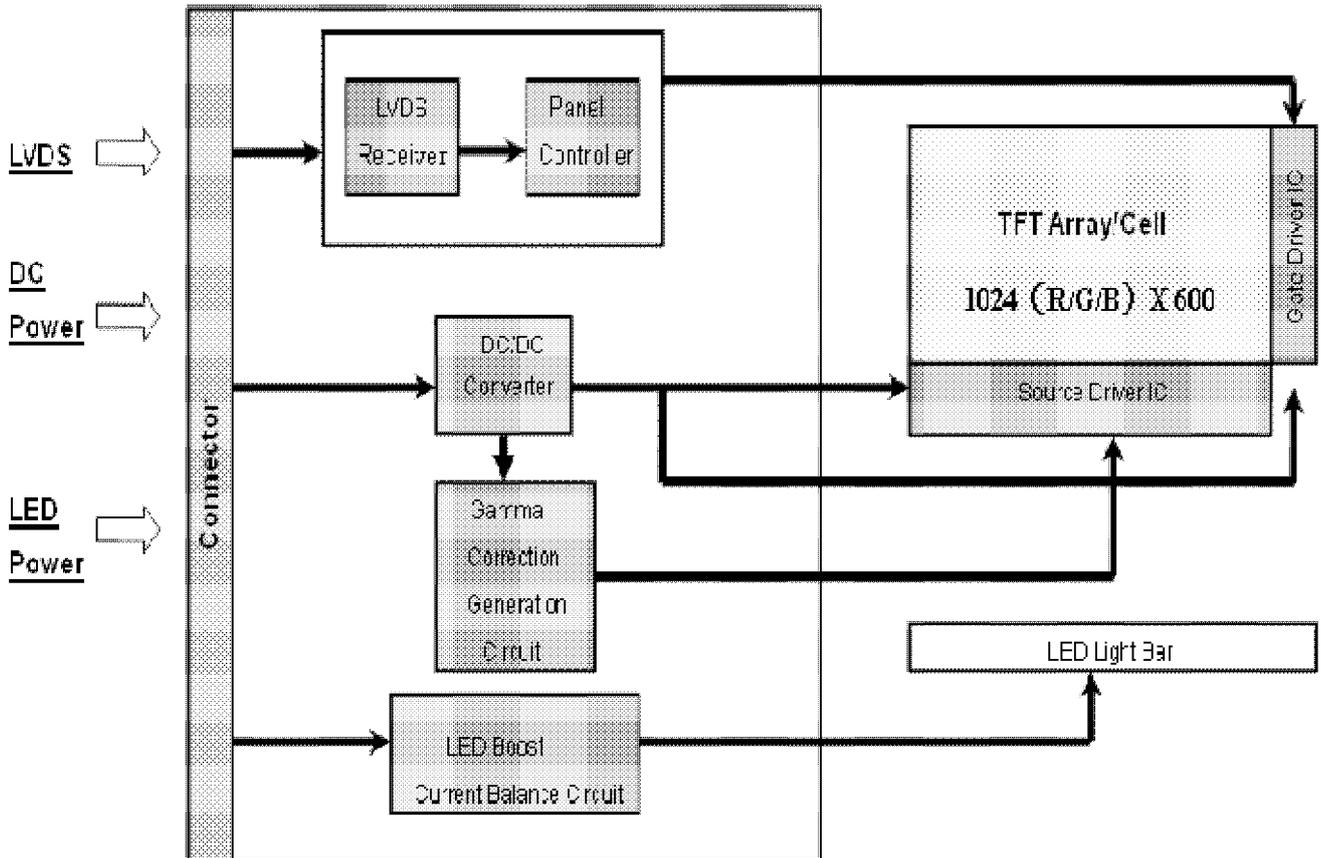
1.3 Product Summary

Items	Specifications	Unit	Remark
Screen Diagonal	10.1	inch	
Active Area	222.72(H) x 125.28(V)	mm	
Pixels (H x V)	1,024 (x3) x 600	-	
Pixel Pitch	0.2175(H) x 0.2088(V)	mm	
Pixel Arrangement	R.G.B. Vertical Stripe	-	
Display Mode	TN Mode, Normally White	-	
White Luminance	200 (Typ.)	cd/ m ²	5 Points Average, 20mA per LED
Contrast Ratio	500 (Typ.)	-	
Response Time	8 (Typ.)	ms	
View Angle (L/R/U/D)	45/45/15/35 (Typ.)	-	
Input Voltage	+3.3 (Typ.)	V	
Power Consumption	2.4	Watt	Black Pattern
Module Weight	190 (Max.)	g	
Outline Dimension (H x V x D)	235.5(H) x 143.5(V) x 5.2(D) (Max.)	mm	
Electrical Interface (Logic)	LVDS	-	
Support Color	262 K	-	
NTSC	45 (Typ.)	%	
Optimum Viewing Direction	12 o'clock	-	Not color Inversion Direction
	6 o'clock	-	CR Max Direction
Surface Treatment	Anti-Glare ,HC	-	Hardness 3H

1.4 Functional Block Diagram

Figure 1 shows the functional block diagram of the LCD module.

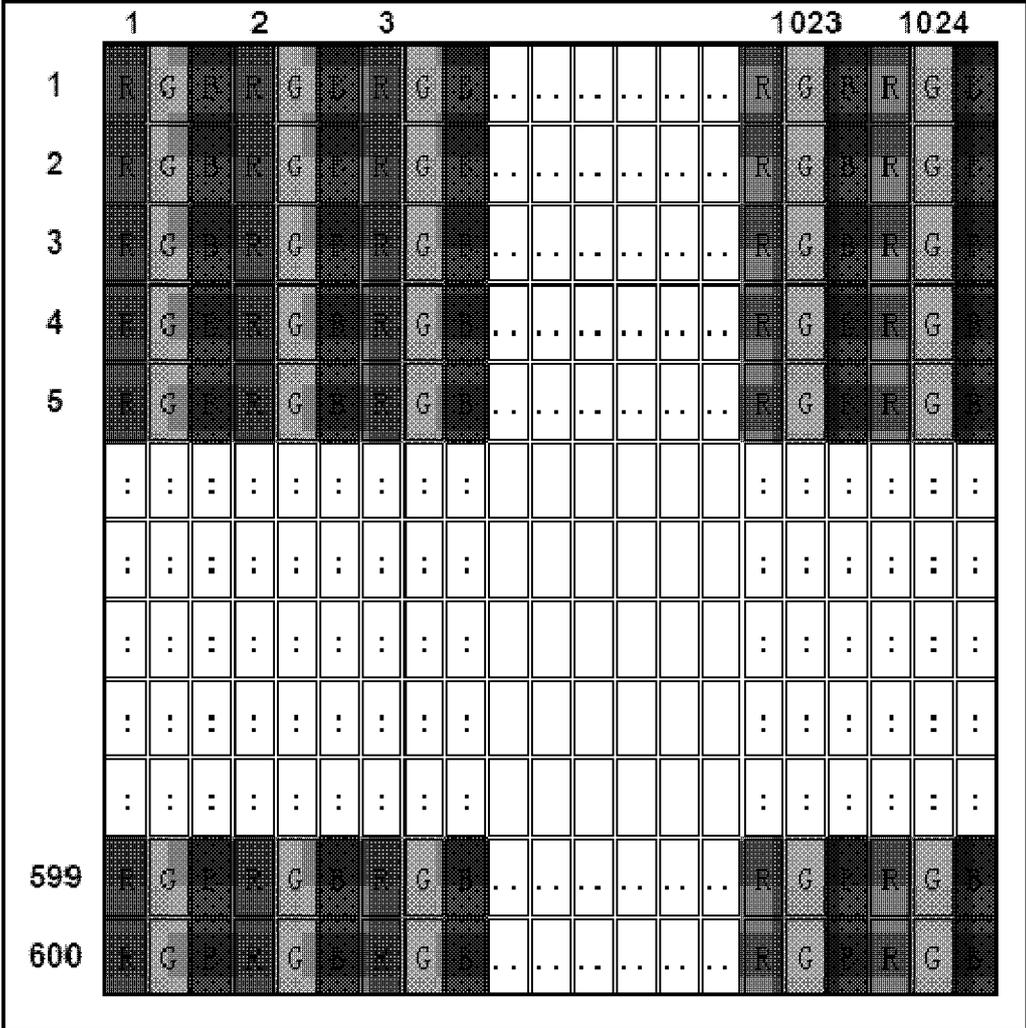
Figure 1 Block Diagram



1.5 Pixel Format Image

Figure 2 shows the relationship of the input signals and LCD pixel format image.

Figure 2 Pixel Format



2. Absolute Maximum Ratings

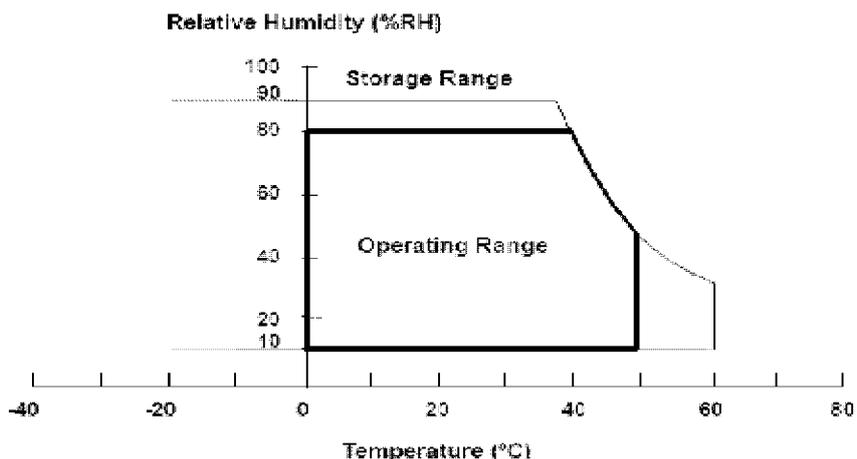
The followings are maximum values which, if exceeded, may cause faulty operation or damage to the LCD module.

Table 1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Supply Voltage	V _{DD}	-0.3	4.0	V	-
Supply V _{LED} Voltage	V _{LED}	5	21	V	-
Input Signal	-	-0.3	2.7	V	LVDS Signals
Operating Temperature	TOP	0	50	°C	Note(3)
Operating Humidity	HOP	10	80	%RH	Note(3)
Storage Temperature	TST	-20	60	°C	Note(3)
Storage Humidity	HST	10	90	%RH	Note(3)
Vibration	Level	-	1.5	G	30min. for X, Y, Z axis
	Bandwidth	-	10~500	Hz	
Shock	Level	-	220	G	Half Sine Waveform, 2ms
LED Current	I _{LED}	-	20.5	mA	Per LED

Note

- (1) Maximum Wet-Bulb should be 39°C and No condensation.
- (2) When you apply the LCD module for OA system. Please make sure to keep the temperature of LCD module under 60°C.
- (3) Storage/Operating temperature & humidity:



3. Electrical Specification

3.1 Electrical Characteristics

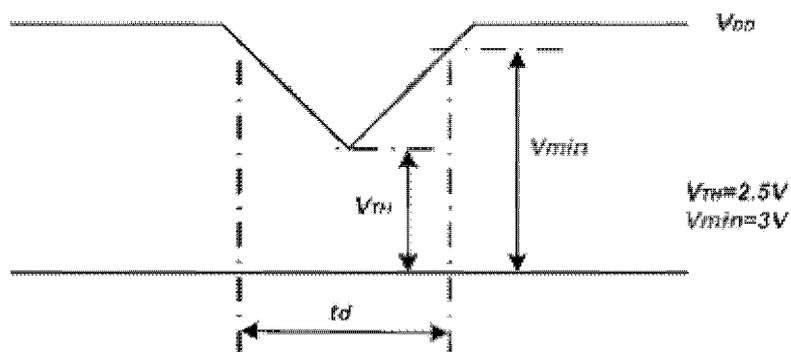
Table 2 Electrical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Condition	
V _{DD}	Logic/LCD Drive Voltage	3	3.3	3.6	V	Note (1)	
I _{DD}	VDD Current	-	160	-	mA	Black Pattern, 60Hz	
P _{DD}	VDD Power	-	-	0.53	W	Black Pattern, 60Hz	
I _{rush}	Rush Current	-	-	2	A	Note (2)	
V _{DDrP}	Allowable Logic/LCD Drive Ripple Voltage	-	-	300	mVp-p	-	
V _{LED}	LED Input	5	12	21	V	-	
V _F	LED Forward Voltage	2.95	3.3	3.4	V	-	
I _F	LED Forward Current	19.5	20	20.5	mA	-	
P _{LED}	LED Power Consumption	-	-	1.87	W	Note(3)	
L _T	LED Life Time	10,000	-	-	Hours	Note(4)	
V _{PWM_EN}	PWM Signal Voltage	High	2	3.3	3.6	V	-
		Low	0	-	0.5	V	
F _{PWM}	Output PWM Frequency	-	200	1K	Hz	-	
V _{LED_EN}	LED Enable Voltage	High	2	3.3	3.6	V	-
		Low	0	-	0.5	V	
PWM	PWM Duty Ratio	5	-	100	%	-	

Note:

(1) V_{DD} Power Dip Condition

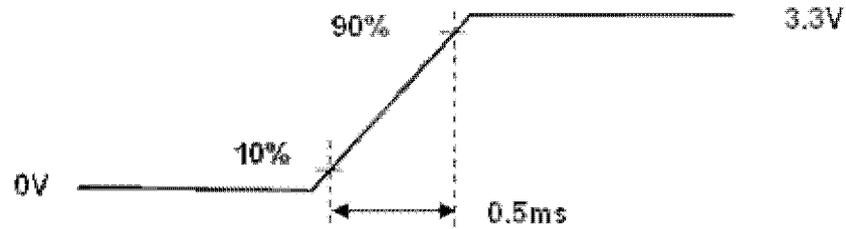
Figure 3 V_{DD} Power Dip



If $V_{TH} < V_{DD} \leq V_{min}$ and $t_d \leq 10ms$, our panel must revive automatically when the voltage returns to normal.

(2) Measure Condition

Figure 4 V_{DD} Rising Time



VDD rising time

- (3) P_{LED} is calculation value for reference. $P_{LED} = 24 \times V_F$ (Normal Distribution) $\times I_F$ (Normal Distribution) / Efficiency
- (4) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25°C and I_F= 20 mA (per chip) until the brightness becomes $\leq 50\%$ of its original value.
- (5) All values are measured at condition of V_{LED} =12V and Ta=25°C.

3.2 Interface Connector

Table 3 Connector Name / Designation

Manufacturer	Starconn/I-PEX (or equivalent)
Type / Part Number	111A40-O000RA-G3(Starconn)
Mating Receptacle / Part Number	20453-040T(I-PEX)

Table 4 Signal Pin Assignment

Pin #	Signal Name	Description	Remarks
1	GND	Ground	
2	V _{DD}	Power Supply 3.3V (Typ.)	
3	V _{DD}	Power Supply 3.3V (Typ.)	
4	V _{EDID}	EDID +3.3V Power	
5	NC	Not Connected(Reserve)	LCD panel self test enable
6	CLK _{EDID}	EDID Clock Input	
7	DAT _{EDID}	EDID Data Input	
8	RXin0-	-LVDS Differential Data Input(R0-R5.G0)	
9	RXin0+	+LVDS Differential Data Input(R0-R5.G0)	
10	GND	Ground	
11	RXin1-	-LVDS Differential Data Input(G1-G5.B0-B1)	
12	RXin1+	+LVDS Differential Data Input(G1-G5.B0-B1)	
13	GND	Ground	
14	RXin2-	-LVDS Differential Data	
15	RXin2+	+LVDS Differential Data	
16	GND	Ground	
17	CLKN-	-LVDS Differential Clock Input	
18	CLKN+	+LVDS Differential Clock Input	
19	NC	Not Connected(Reserve)	
20	NC	Not Connected(Reserve)	
21	NC	Not Connected(Reserve)	
22	GND	Ground-Shield	
23	NC	Not Connected(Reserve)	
24	NC	Not Connected(Reserve)	
25	GND	Ground-Shield	
26	NC	Not Connected(Reserve)	
27	NC	Not Connected(Reserve)	
28	GND	Ground-Shield	

Pin #	Signal Name	Description	Remarks
29	NC	Not Connected(Reserve)	
30	NC	Not Connected(Reserve)	
31	V_LED_GND	LED Ground	
32	V_LED_GND	LED Ground	
33	V_LED_GND	LED Ground	
34	NC	Not Connected(Reserve)	
35	V_PWM_EN	System PWM Logic Input Level	
36	V_LED_EN	LED Enable Input Level(+3.3V)	
37	NC	Not Connected(Reserve)	
38	V_LED	LED Power Supply 5-21V	
39	V_LED	LED Power Supply 5-21V	
40	V_LED	LED Power Supply 5-21V	

Note: All input signals shall be at low or Hi-Z state when V_{DD} is off.

3.3 LVDS Receiver

3.3.1 Signal Electrical Characteristics For LVDS Receiver

The built-in LVDS receiver is compatible with (ANSI/TIA/TIA-644) standard.

Table 5 LVDS Receiver Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Differential Input High Threshold	V _{th}	-	-	+100	mV	V _{cm} =+1.2V
Differential Input Low Threshold	V _{tl}	-100	-	-	mV	V _{cm} =+1.2V
Magnitude Differential Input Voltage	V _{id}	100	-	600	mV	
Common Mode Voltage	V _{cm}	V _{id} /2 +0.6	1.2	1.8- V _{id} /2	V	
Common Mode Voltage Offset	ΔV _{cm}	-	-	50	mV	V _{cm} =+1.2V

Note:

- (1) Input signals shall be at low or Hi-Z state when V_{DD} is off.
- (2) All electrical characteristics for LVDS signal are defined and shall be measured at the interface connector of LCD.
- (3) All values are measured at condition of V_{DD} =3.3V and Ta=25°C.

Figure 5 Voltage Definitions

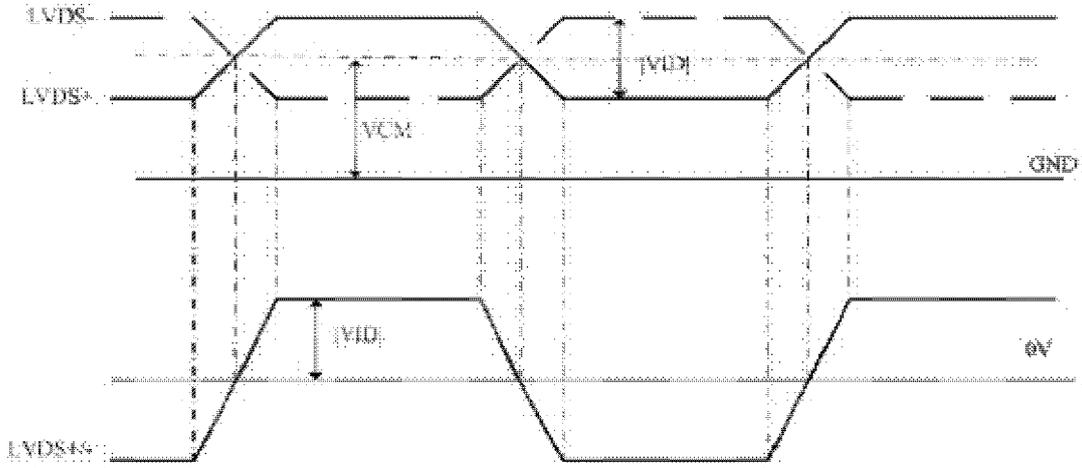


Figure 6 Measurement System

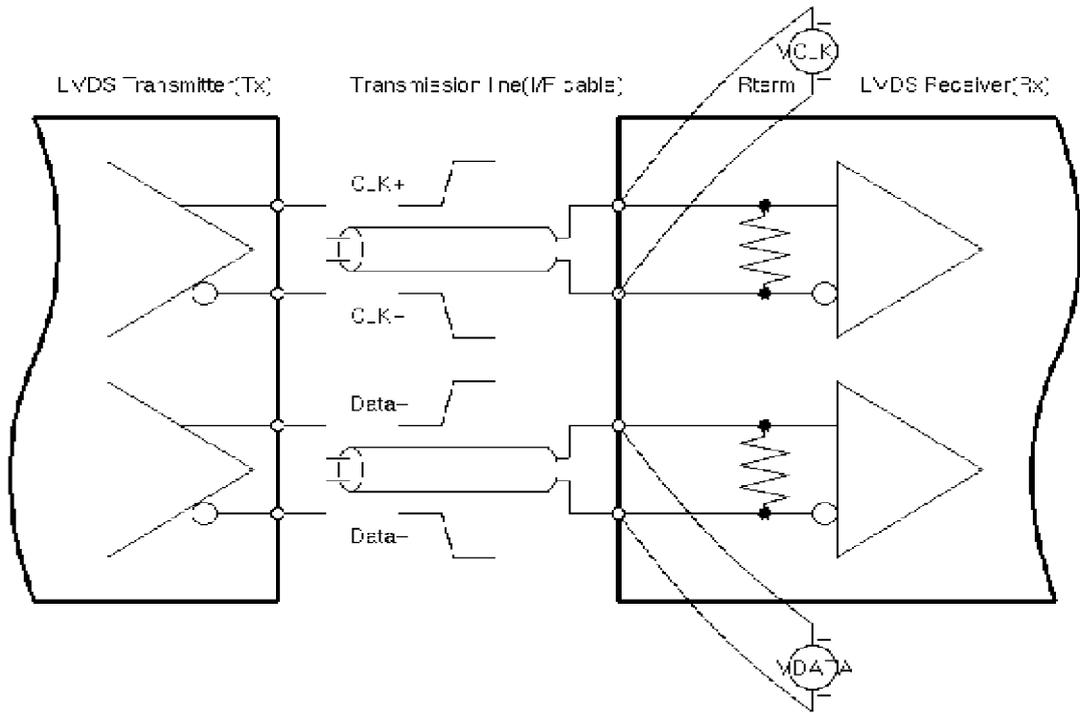
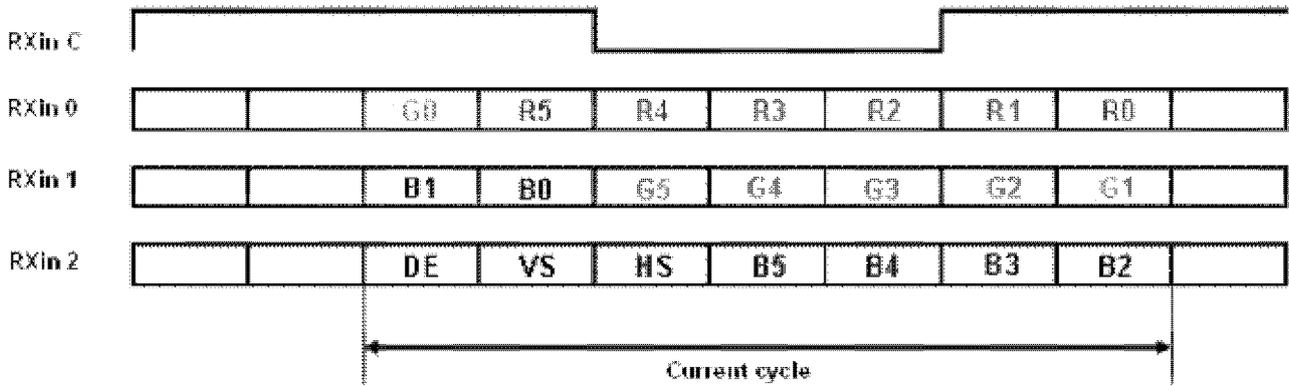


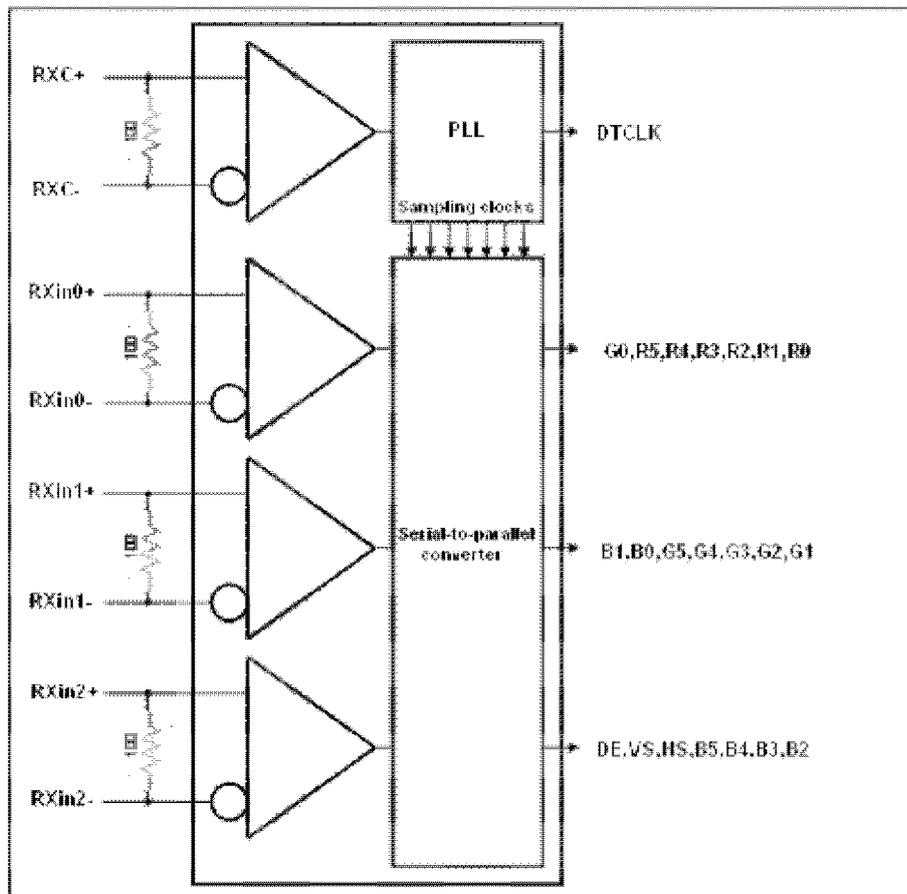
Figure 7 Data mapping



3.3.2 LVDS Receiver Internal Circuit

Figure 8 LVDS Receiver Internal Circuit shows the internal block diagram of the LVDS receiver. This LCD module equips termination resistors for LVDS link.

Figure 8 LVDS Receiver Internal Circuit

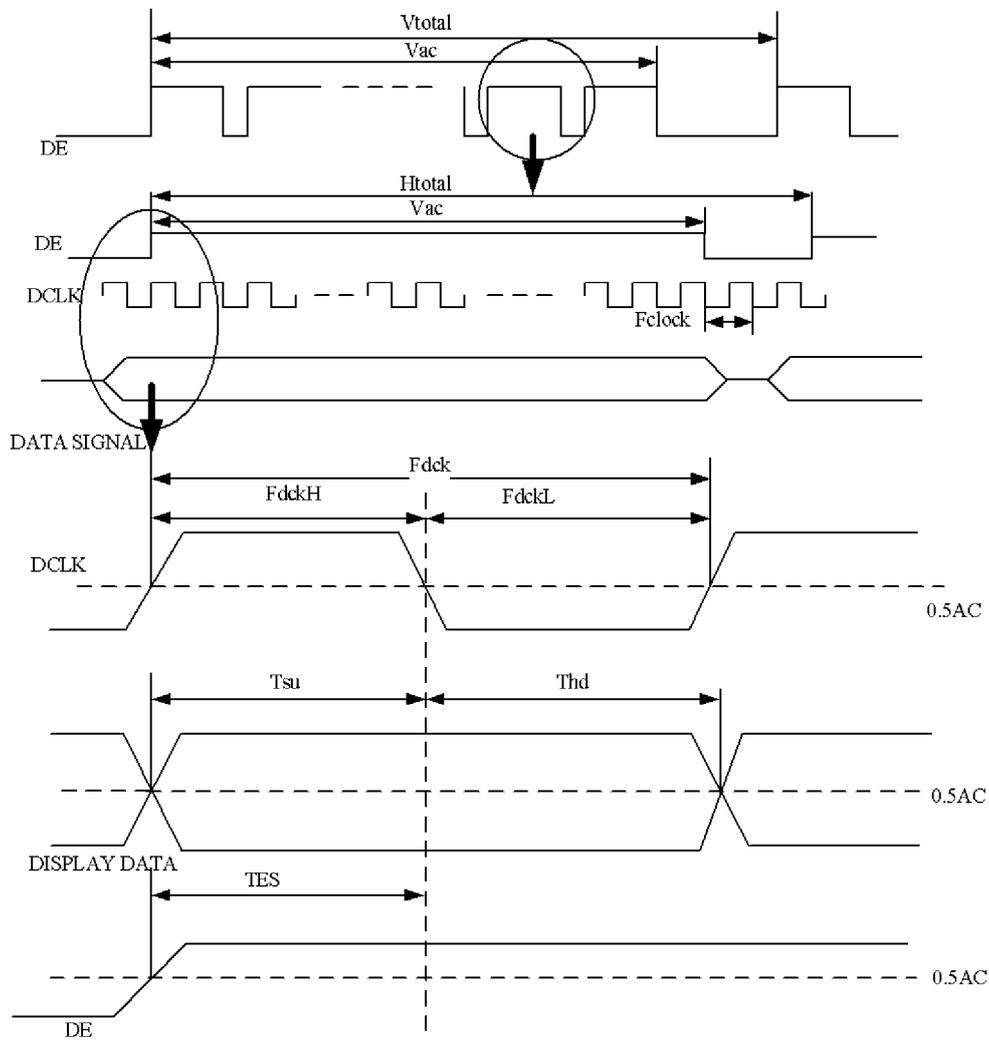


3.4 Interface Timings

Table 6 Interface Timings

Parameter	Symbol	Unit	Min.	Typ.	Max.
LVDS Clock Frequency(single)	F_{dck}	MHz	44.4	50.4	65.2
H Total Time	H_{total}	Clocks	1,320	1,344	1,362
H Active Time	H_{ac}	Clocks	1,024	1,024	1,024
V Total Time	V_{total}	Lines	612	625	638
V Active Time	V_{ac}	Lines	600	600	600
Frame Rate	V_{sync}	Hz	55	60	65

Figure 9 Timing Characteristics



Note: TES is data enable signal setup time.

3.5 Power ON/OFF Sequence

V_{DD} power, interface signals, and lamp on/off sequence are showing on Figure 10. Signals shall be Hi-Z state or low level when V_{DD} is off.

Figure 10 Power Sequence

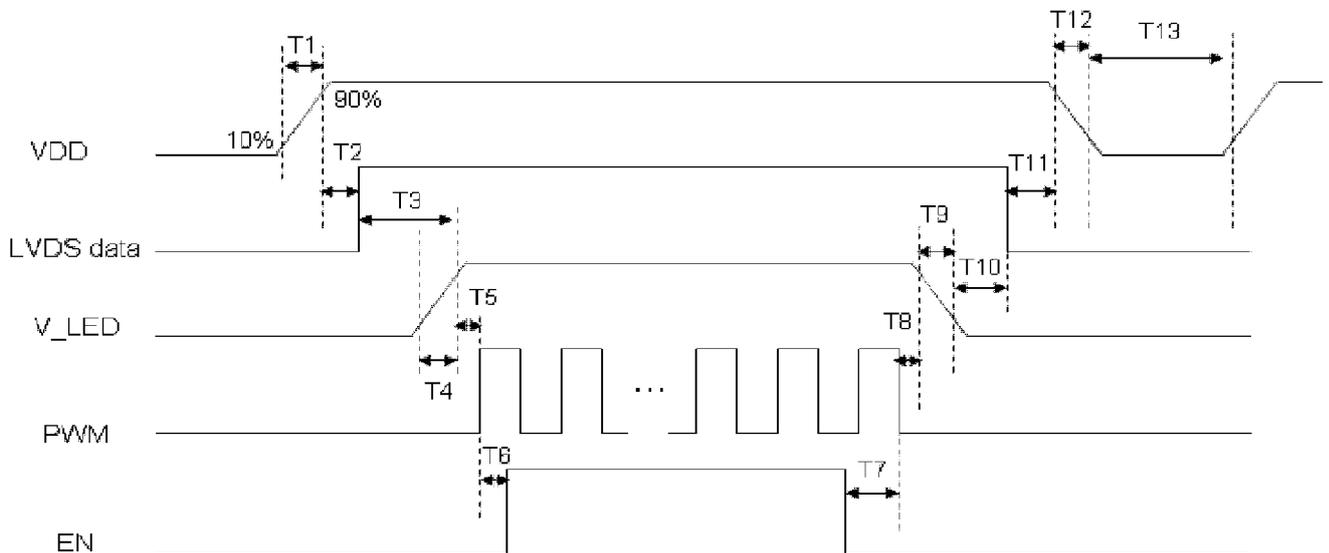


Table 7 Power Sequencing Requirements

Parameter	Symbol	Min.	Typ.	Max.	Unit
V_{DD} Rising Time	T1	0.5	-	10	ms
V_{DD} Good to Signal Valid	T2	30	-	90	ms
Signal Valid to Backlight On	T3	200	-	-	ms
Backlight Power On Time	T4	0.5	-	-	ms
Backlight V_{DD} Good to System PWM On	T5	10	-	-	ms
System PWM on to Backlight Enable On	T6	10	-	-	ms
Backlight Enable Off to System PWM Off	T7	0	-	-	ms
System PWM Off to B/L Power Disable	T8	10	-	-	ms
Backlight Power Off Time	T9	-	10	30	ms
Backlight Off to Signal Disable	T10	200	-	-	ms
Signal Disable to Power Down	T11	0	-	50	ms
V_{DD} Falling Time	T12	-	10	30	ms
Power Off	T13	500	-	-	ms

4. Optical Characteristics

The optical characteristics are measured under stable conditions as following notes.

Table 8 Optical Characteristics

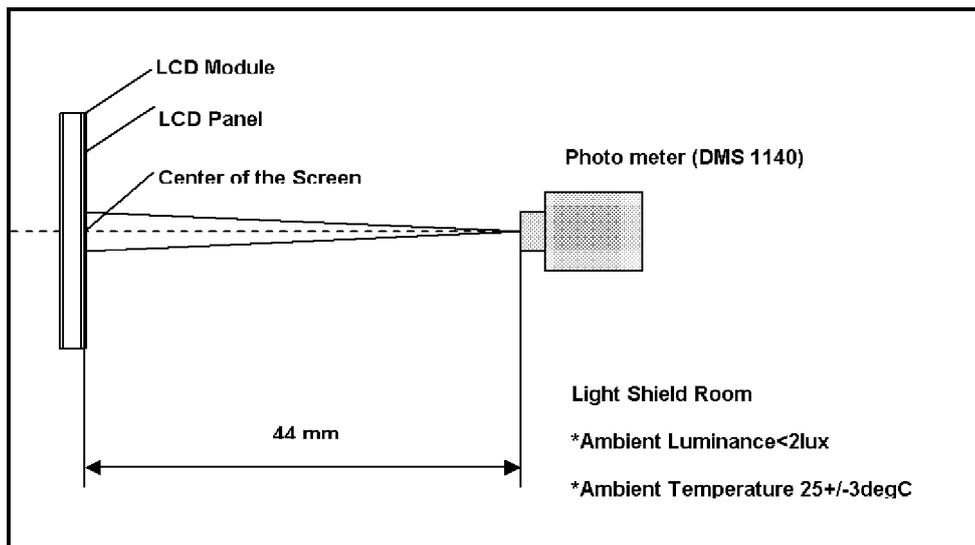
Item	Conditions		Specification				
			Min.	Typ.	Max.	Unit	Note
Viewing Angle [degrees] K=Contrast Ratio>10	Horizontal	Left	40	45	-	Deg.	(1),(2)
		Right	40	45	-	Deg.	
	Vertical	Up	10	15	-	Deg.	
		Down	30	35	-	Deg.	
Contrast Ratio	Center		400	500	-	-	(1),(3)
Response Time	Rising		-	3	-	ms	
	Falling		-	5	-	ms	
	Rising + Falling		-	8	16	ms	(1),(4)
Color Chromaticity (CIE1931)	Red	x	Typ. -0.03	0.579	Typ. +0.03	-	(1)
	Red	y		0.346		-	(1)
	Green	x		0.336		-	(1)
	Green	y		0.560		-	(1)
	Blue	x		0.156		-	(1)
	Blue	y		0.123		-	(1)
	White	x	0.283	0.313	0.343	-	(1)
	White	y	0.299	0.329	0.359	-	(1)
White Luminance [cd/m ²]	I _{LED} =20.0mA		180	200	-	cd/m ²	(1), (5)
Luminance Uniformity [%]	I _{LED} =20mA, 13points		62.5	-	-	%	(1), (6)
	I _{LED} =20mA, 5points		80.0	-	-		

Note:

(1) Measurement Setup

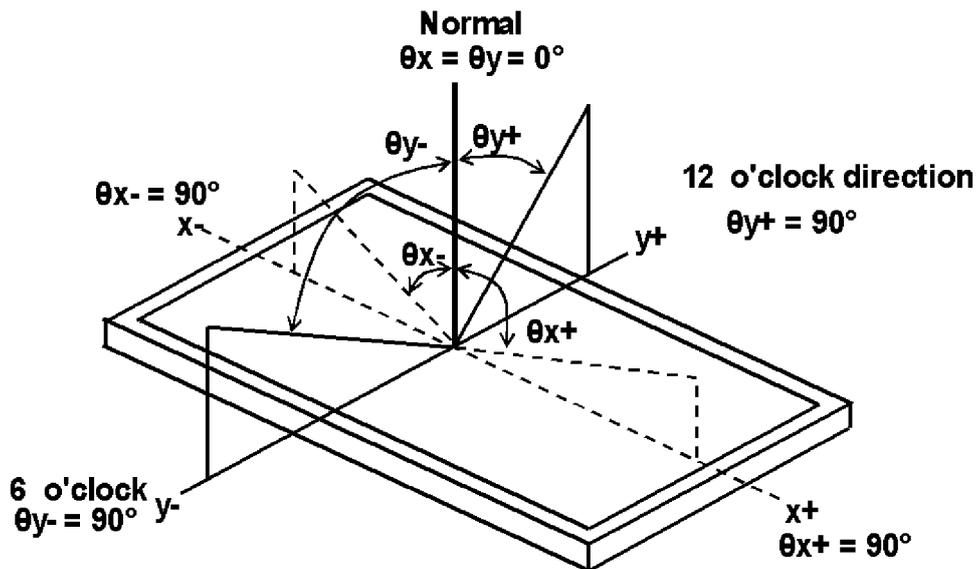
The LCD module should be stabilized at 25°C for 15 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 15 minutes in a windless room.

Figure 11 Measurement Setup



(2) Definition of Viewing Angle

Figure 12 Definition of Viewing Angle



(3) Definition of Contrast Ratio (CR)

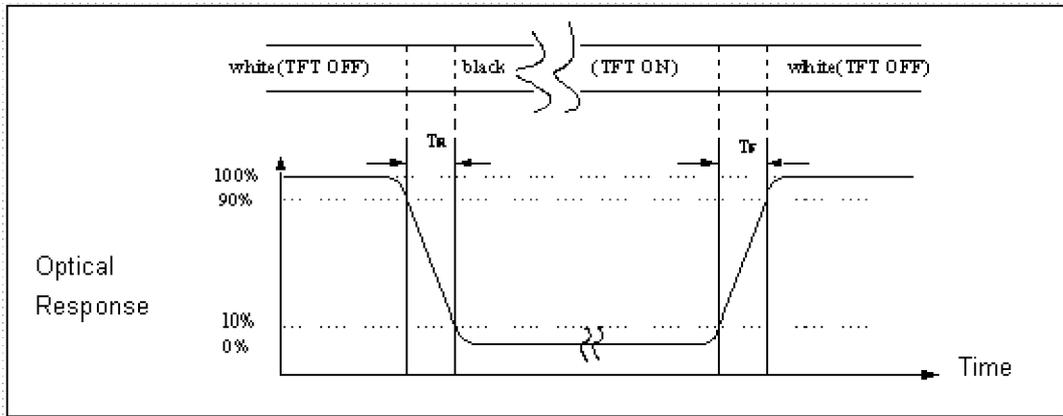
The contrast ratio can be calculated by the following expression

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

L63: Luminance of gray level 63, L0: Luminance of gray level 0

(4) Definition of Response Time (T_R , T_F)

Figure 13 Definition of Response Time



(5) Definition of Luminance White

Measure the luminance of gray level 63 at 5 points. (Fig.14).

Center of Luminance = Y_1

$$\text{Average Luminance of 5 points} = \frac{Y_1 + Y_2 + Y_3 + Y_4 + Y_5}{5}$$

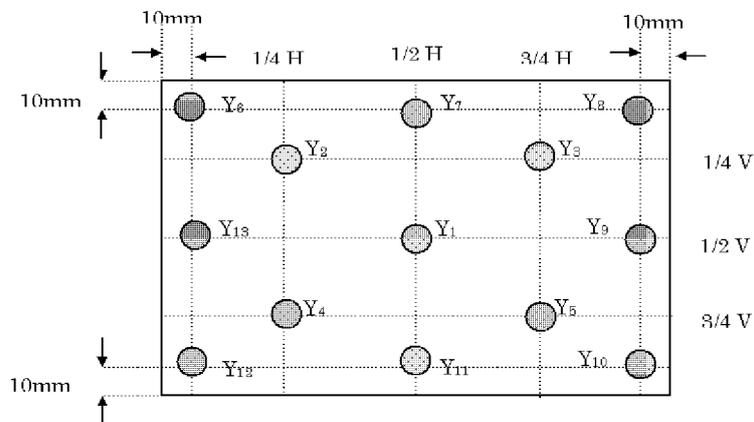
(6) Definition of Luminance Uniformity (Variation)

Measure the luminance of gray level 63 at 13 points.

$$\text{Uniformity of 13 points} = \frac{\text{Min Luminance of } Y_1 \sim Y_{13}}{\text{Max Luminance of } Y_1 \sim Y_{13}} \times 100\%$$

$$\text{Uniformity of 5 points} = \frac{\text{Min Luminance of } Y_1 \sim Y_5}{\text{Max Luminance of } Y_1 \sim Y_5} \times 100\%$$

Figure 14 Measurement Locations of 13 Points



5. Mechanical Characteristics

5.1 Outline Drawing

Figure 15 Reference Outline Drawing (Front Side)

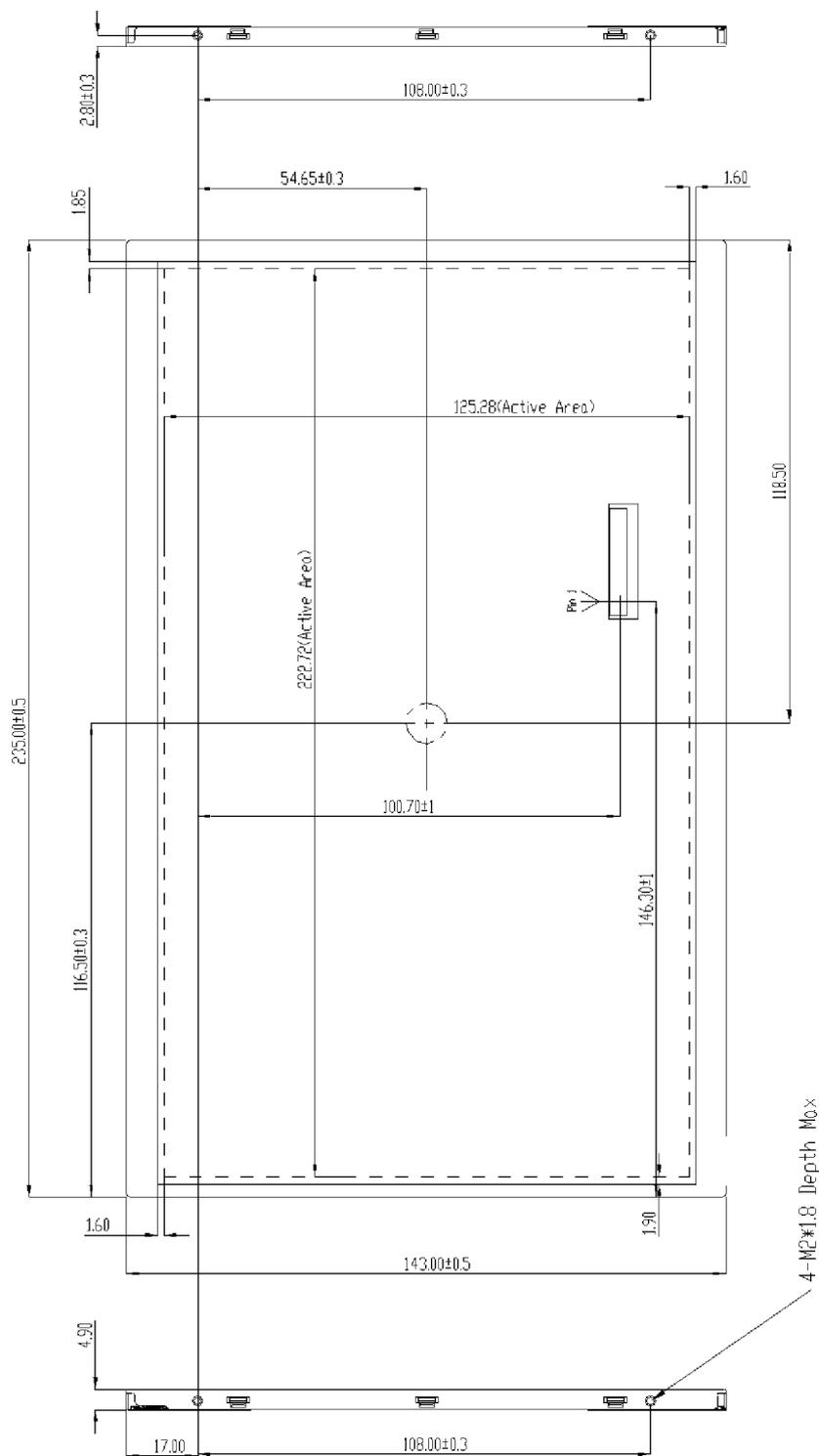
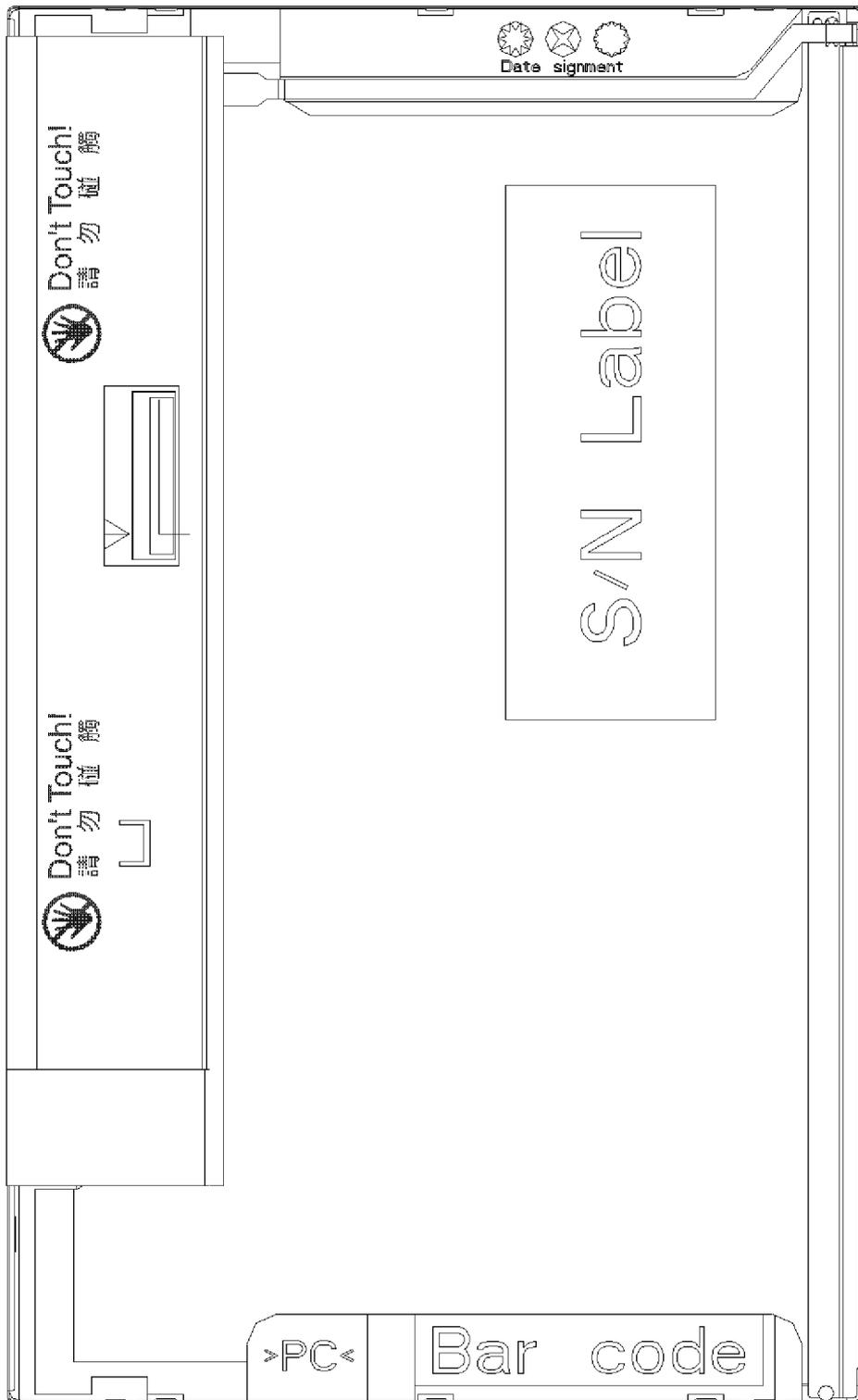


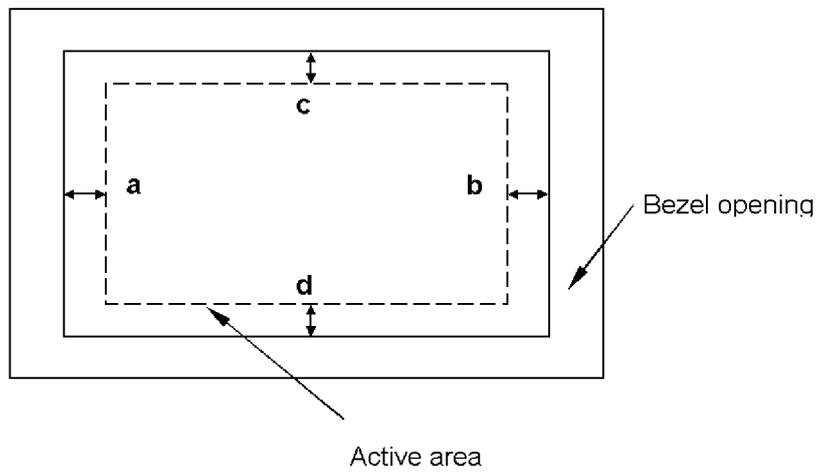
Figure 16 Reference Outline Drawing (Back Side)



5.2 Dimension Specifications

Table 9 Module Dimension Specifications

Item		Value	Unit
Width		235.00±0.5	mm
Height		143.00±0.5	mm
Thickness (Max.)		5.2	mm
Bezel Opening	X	226.47±0.5	mm
	Y	128.48±0.5	mm
Weight (Max.)		190	g
BM Width	a-b & c-d	≤1.0	mm



6. Inspection Standards for LCD Modules

6.1 Description

These inspection standards shall be applied to LCD Module supplied by Optrex Corporation.

6.2 The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature:15~25°C
- (2) Humidity:25~75%RH
- (3) External appearance inspection shall be conducted by using a single 20W fluorescent lamp or equivalent illumination.
- (4) Panel visual inspection on the operation condition for cosmetic shall be conducted at the distance 35cm or more between the LCD module and eyes of inspector. And, the viewing angle shall be 90 degree to the front surface of display panel
Ambient Illumination: 400~600 Lux for external appearance inspection
Ambient Illumination:100~200 Lux for light on inspection

6.3 Method of sampling inspection

Unless defined in the other document, the sampling method shall be in accordance with MIL-STD-105E.

- (1) Lot size: quantity of per delivery for inspection per model
- (2) Sampling type: Normal inspection, single sampling
- (3) Sampling table: MIL-STD-105E

6.4 Classification of defects

Defects are classified two types, major defect according to the defect. And, the definition of defects is classified as below.

- (1) Major defect
Any defect may result in functional failure, or reduce the usability of product for its purpose. For example, electrical failure, deformation and etc..
- (2) Minor defect
A defect that is not to reduce the usability of product for its intended purpose and un-uniformity, dot defect and etc..
The criteria on major and/or minor judgment will be according with the classification of defects.

6.5 Acceptable quality level (AQL)

AQL means that the quality level of product is acceptable for shipment, and the AQL shall satisfy with customer's quality request.

The AQL (%) for major or minor defect are expressed as below respectively.

(1) Major defect::0.4%

(2) Minor defect::1.0%

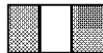
6.6 Inspection Criteria

6.6.1 Definition of dot defect

- a) The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot
- b) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
- c) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.
- d) 2 dot adjacent=1 pair=2dots



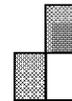
2 dot adjacent



2 dot adjacent



2 dot adjacent(vertical)



2 dot adjacent(slant)

6.6.2 Display Inspection criteria

Item		Acceptable count
Bright dot	Random	$N \leq 2$
	2 dots adjacent (pair)	$N=0$
	3 dots adjacent or more	$N=0$
Dark dot	Random	$N \leq 4$
	2 dots adjacent (pair)	$N=0$
	3 dots adjacent or more	$N=0$
Distance	Minimum Distance Between Bright dots	$L \geq 15\text{mm}$
	Minimum Distance Between Dark dots	$L \geq 5\text{mm}$
Total bright and dark dot		$N \leq 4$
Display failure (V-line/H-line/Cross line etc.)		Not allowable
Mura	Judge by limit sample or not visible through ND filter	6%

6.6.3 Appearance inspection criteria

Item	Standards
Foreign Black / White Spots	$0.15\text{mm} < D \leq 0.5\text{mm}$, $N \leq 4$
Foreign Lint	$0.05\text{mm} < W \leq 0.1\text{mm}$, $0.5\text{mm} < L \leq 5.0\text{mm}$, $N \leq 4$
Polarizer Bubble/Dent	$0.15\text{mm} < D \leq 0.5\text{mm}$, $N \leq 3$
Polarizer Scratches	$0.05\text{mm} < W \leq 0.1\text{mm}$, $1.0\text{mm} < L \leq 10.0\text{mm}$, $N \leq 3$

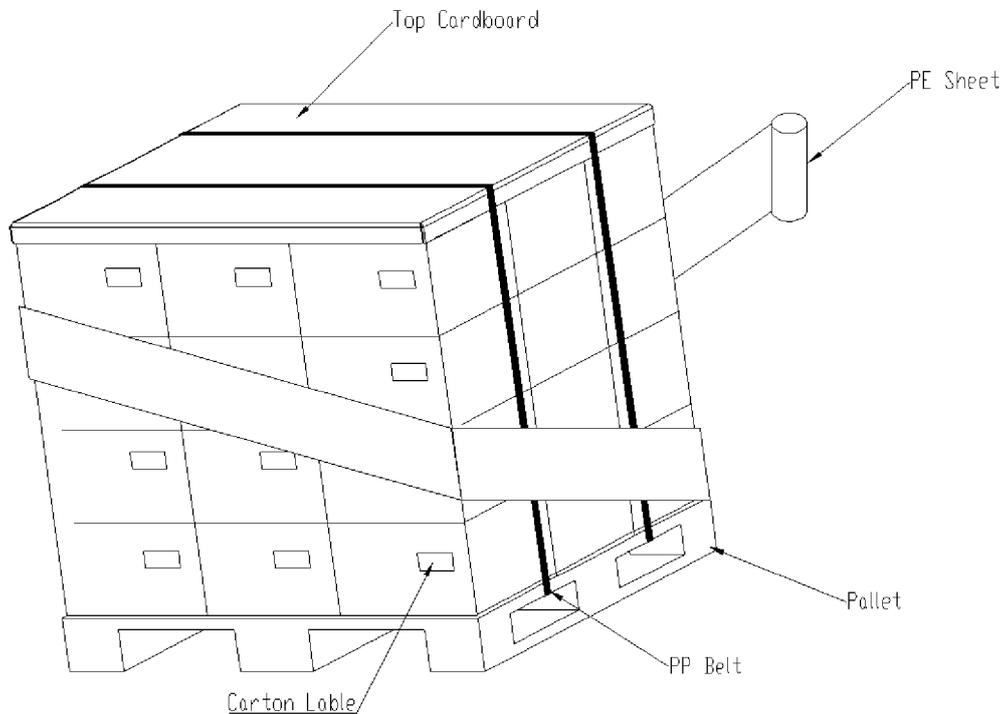
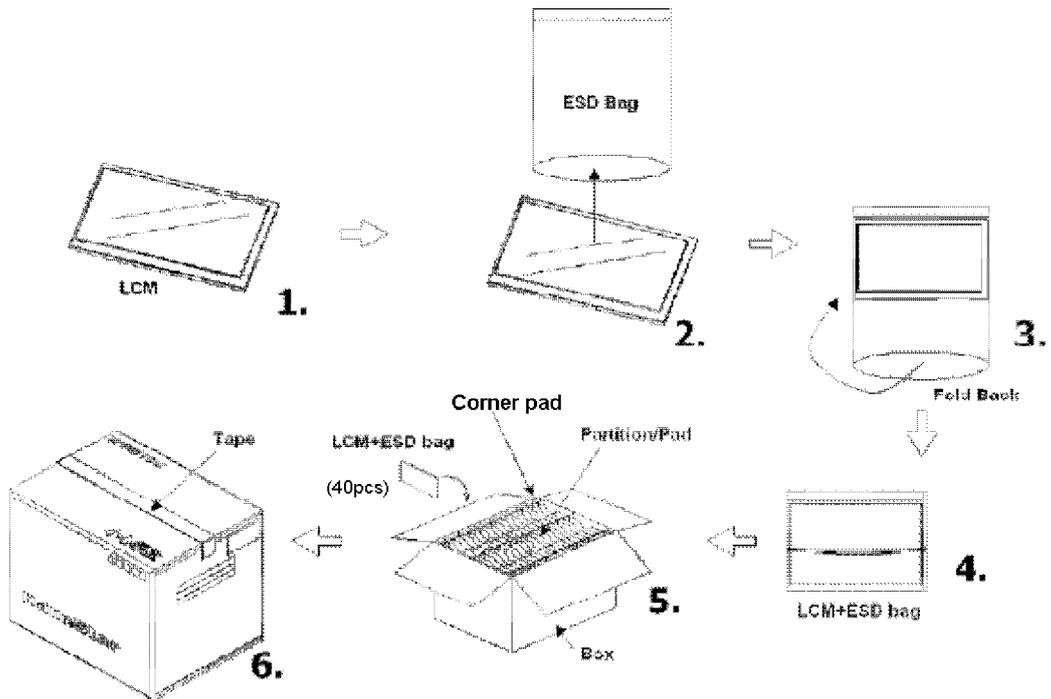
6.6.4 External appearance inspection criteria

Item	Contents	
Screw	Parts mounting, incomplete assembly, deformation, oxidized, crooked or rusty is not permitted.	
Metal frame (Bezel)	Scratch	*Noticeable scratch and exfoliation coating are not permitted. *The oxidized metal is not permitted.
	Incomplete assembly is not permitted.	
Backlight	Scratch	The scratch which may causes a problem in practical use is not permitted.
	Break-off	Breaking off is not permitted.
	Crack	The crack is not permitted.
Stain on Polarizer	The stain which can't be wiped off is not permitted.	
Tape/Label	Incorrect position, missed label is not permitted.	
Connector	Oxidized/rusty connector is not permitted.	
Outline size	Spec. out is not permitted.	

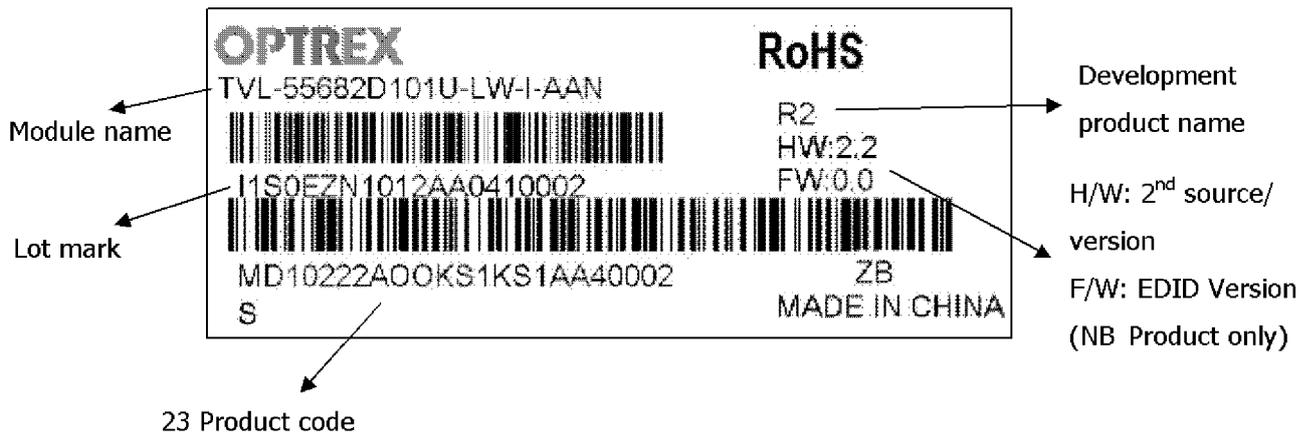
6.6.5. Classification of defects

Inspection Item	Criteria and Description	Defect type
Vertical line	Signal input, vertical line off or abnormal V-line appears	Major
Horizontal line	Signal input, horizontal line off or abnormal H-line appears	Major
Cross line	Pattern signal input, a correct display is not obtained	Major
No display	Signal input, display is dead	Major
Abnormal display	Pattern signal input, a correct display is not obtained	Major
Bezel finger	Bezel finger is missed or not bent	Major
Outline size	Length, Wide, High,	Major
Dots defect	Exceed specified standards	Minor
Light leakage	Visible light leakage appears around the edges of screen	Minor
Foreign material	Exceed specified standards	Minor
External Appearance	A appearance defect that do not affect function or performance	Minor
Polarizer bubble	Exceed specified standards	Minor

7. Package Specification



8. Lot Mark



8.1 Lot Mark

1	2	3	4	5	6	7	8	9	1	1	1	1	1	1	1	1	1	1	2
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Code 1,2,4,5,6,7,8,9,10,11,16: Internal flow control code.

Code 3: Production Location.

Code 12: Production Year.

Code 13: Production Month.

Code 14,15: Production Date.

Code 17,18,19,20: Serial Number.

Note (1) Production Year

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mark	6	7	8	9	A	B	C	D	E	F

Note (2) Production Month

Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct	Nov.	Dec.
Mark	1	2	3	4	5	6	7	8	9	A	B	C

8.2 23 Product Barcode

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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Code 1,2: MD Module Domain.

Code 3,4,5,6,7: Internal Module Name.

Code 8,9,10,13,16: Internal Flow Control Code.

Code 11,12: Cell line code "SZ".

Code 14,15: Module line code "KS".

Code 17,18,19: Year, Month, Day Refer to Barcode Note(1),Note(2).

Code 20~23: Serial Number.

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9. General Precaution

9.1 Use Restriction

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life-threatening or otherwise catastrophic.

9.2 Handling Precaution

- 1) Please mount LCD module by using mounting holes arranged in four corners tightly.
- 2) Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. Optrex does not warrant the module, if customers disassemble or modify the module.
- 3) If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin. If liquid crystal contacts mouth or eyes, rinse out with water immediately. If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and Rinse thoroughly with water.
- 4) Disconnect power supply before handling LCD module.
- 5) Refrain from strong mechanical shock and /or any force to the module.
- 6) Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature; etc otherwise LCD module may be damaged. It's recommended employing protection circuit for power supply.
- 7) Do not touch, push or rub the polarizer with anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- 8) When the surface is dusty, please wipe gently with absorbent cotton or other soft Material. When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- 9) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- 10) Protection film must be removed very slowly from the surface of LCD module to prevent from electrostatic occurrence.
- 11) Because LCD module uses CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge, Please be careful with electrostatic discharge .Persons who handle the module should be grounded through adequate methods.
- 12) Do not adjust the variable resistor located on the module.

9.3 Storage Precaution

- 1) Please do not leave LCD module in the environment of high humidity and high temperature for a long time.
- 2) The module shall not be exposed under strong light such as direct sunlight. Otherwise, Display characteristics may be changed.
- 3) The module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storage.

9.4 Operation Precaution

- 1) Do not connect or disconnect the module in the "Power On" condition.
- 2) Power supply should always be turned on/off by 9.0 "Power on/off sequence".
- 3) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- 4) After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/ twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.

9.5 Others

- 1) Ultra-violet ray filter is necessary for outdoor operation.
- 2) Avoid condensation of water which may result in improper operation or disconnection of electrode.
- 3) If the module keeps displaying the same pattern for a long period of time, the image may be "Sticked" to the screen.
- 4) This module has its circuitry PCB on the rear side and should be handled carefully in order not to be stressed.

9.6 Disposal

When disposing LCD module, obey the local environmental regulations.