

21.5" FHD
High brightness color TFT-LCD module

Model: VM22B2 V4

Date: Dec. 25th, 2019

**Note: This specification is subject to change
without notice**

Customer : _____

Date : _____

Approved

Prepared

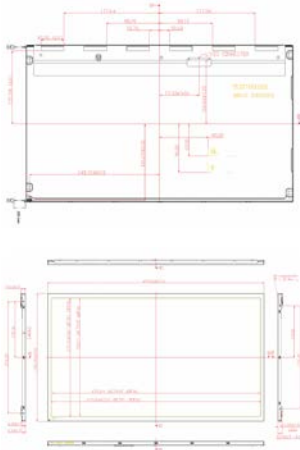
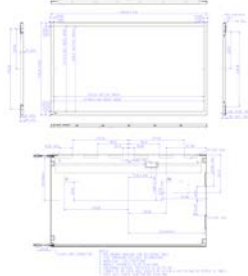
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Contents

- 1. Handling Precautions**
- 2. General Description**
 - 2.1 Overview
 - 2.2 Features
 - 2.3 Application
 - 2.4 Display specifications
 - 2.5 Optical characteristics
- 3. Function block diagram**
- 4. Absolute Maximum Ratings**
 - 4.1 TFT LCD module
 - 4.2 Backlight unit
 - 4.3 Environment
- 5. Electrical characteristics**
 - 5.1 TFT LCD module
 - 5.1.1 Power specification
 - 5.1.2 Signal electrical characteristics
 - 5.2 Backlight unit
 - 5.3 Interface connector
 - 5.3.1 TFT connector(CN1)
 - 5.3.2 Backlight connector(CN2)
- 6. Signal characteristics**
 - 6.1 Pixel format image
 - 6.2 The input data format
 - 6.3 Color versus input data
 - 6.4 Input timing specification
 - 6.5 Input timing diagram
 - 6.6 Power ON/OFF sequence
- 7. Reliability Test**
- 8. Shipping package**
- 9. Mechanical Characteristics**

RECORD OF REVISION

Version and Date	Page	Old description	New description	Remark
0.1 2014/06/30	All	First Edition for customer		
0.2 2014/10/30	15		LED bar current : 500mA	
0.3 2015/12/30	7		CIE max/min ± 0.05	
0.4 2019/12/25	6	Power : 41.2W	Power : 34.3W	
		LED power : 37.2W	LED power : 31.2W	
	15	LED voltage : 37.2	LED voltage : 39V	
		LED current : 500mA	LED current : 400mA	
		LED power : 37.2W	LED power : 31.2W	
	26			

1. Handling Precautions

- 1) Since front polarizer is easily damaged, pay attention not to scratch it.
- 2) Be sure to turn off power supply when inserting or disconnecting from input connector.
- 3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- 4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- 5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
- 6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- 7) Do not open or modify the Module Assembly.
- 8) Do not press the reflector sheet at the back of the module to any directions.
- 9) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
- 10) 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.

2. General Description

2.1 Overview

This specification applies to the Color Active Matrix Liquid Crystal Display composed of a TFT-LCD display a LED backlight system. The screen format is intended to support FHD (1920(H) x 1080(V)) screen and 16.7M colors.

LED driving board for backlight unit is not included.

2.2 Features

- High brightness display, 1000nits by LED backlight.
- Long operation lifetime BLU design
- RoHS Compliance

2.3 Application

Industrial applications.

2.4 Display specifications

Items	Unit	Specification
Screen Diagonal	mm	21.5 inch
Active Area	mm	476.64 (H) X 268.11 (V)
Pixels H x V	pixels	1920 x3(RGB) x 1080
Pixels Pitch	um	248.25 (per one triad) x 248.25
Pixel Arrangement		RGB Vertical stripe
Display mode		Normally Black
White luminance (center)	Cd/m ²	1000 (Typ)
Contrast ratio		3000:1 (Typ.)
Optical Response Time	msec	18 ms (Typ. On/off)
Normal Input Voltage VDD	Volt	12.0
Power Consumption (Vcc Line + LED backlight)	Watt	34.3W (VDD line=3.1 W; LED lines= 31.2 W)
Weight	Grams	TBD
Physical size	mm	495.6 (W)×292.2(H)×10.6(D)
Electrical Interface		LVDS
Support colors		16.7M colors
Surface Treatment		Anti-glare and hard-coating 3H
Temperature range		
Operating	°C	-10 ~ 50
Storage	°C	-20 ~ 60
RoHS Compliance		RoHS Compliance
TCO compliance		TCO 7.0 compliance

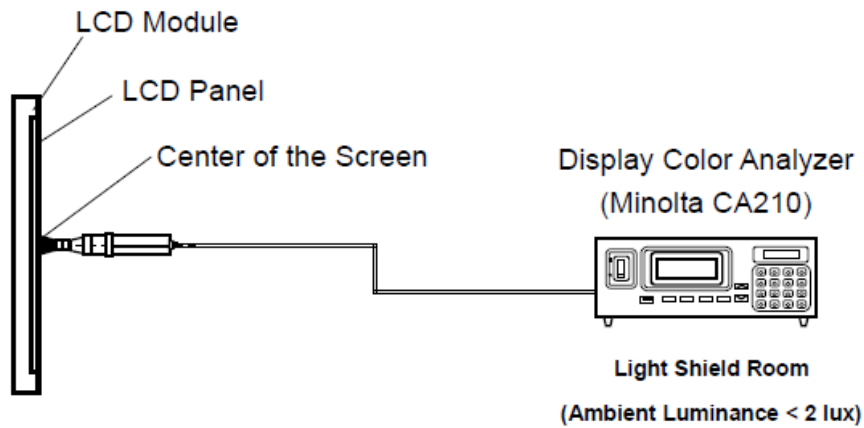
2.5 Optical characteristics

The following optical characteristics are measured under stable condition at 25 °C

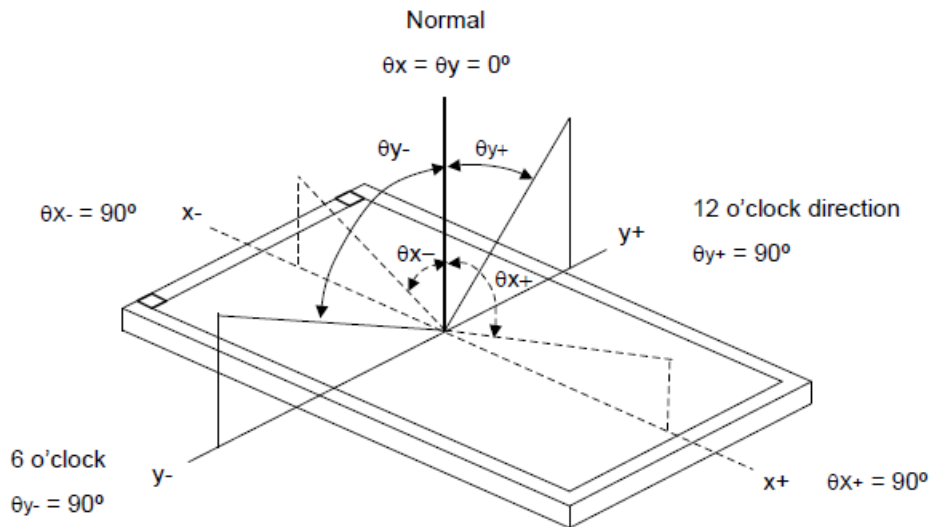
Items	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing angle	Deg.	Horizontal (Right)	75	89		2
		CR=10 (Left)	75	89		
		Vertical (Up)	75	89		
		CR=10 (Down)	75	89		
Contrast Ratio		Normal Direction	2000	3000		3
Response Time	msec	Raising + Falling		18	36	4
Color / Chromaticity Coordinates (CIE)		Red x	-0.05	0.652	+0.05	5
		Red y		0.335		
		Green x		0.321		
		Green y		0.625		
		Blue x		0.153		
		Blue y		0.067		
Color coordinates (CIE) White		White x		0.313		
		White y		0.329		
Center Luminance	Cd/m ²		800	1000		6
Luminance Uniformity	%		70	75		7
Crosstalk (in 60 Hz)	%				1.5	
Flicker	dB				-20	

Note 1: Measurement method

The LCD module should be stabilized at given temperature for 0.5 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



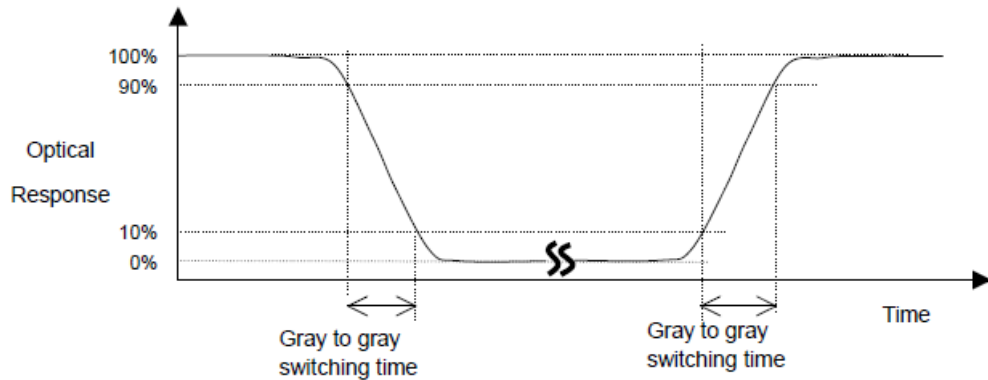
Note 2: Definition of viewing angle



Note 3: Contrast ratio is measured by Minolta CA210

Note 4: Definition of Response time

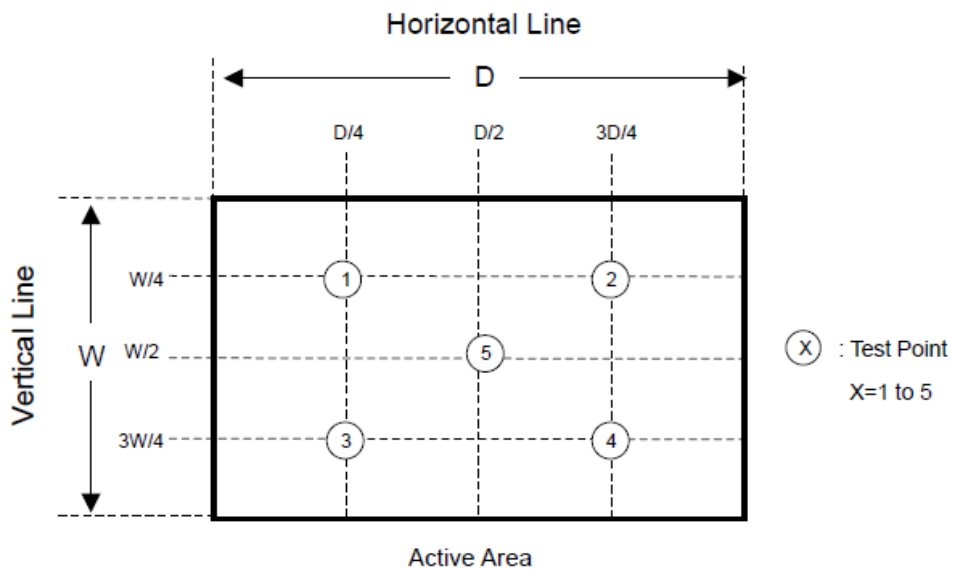
The output signals of photo detector are measured when the input signals are changed from “Full Black” to “Full White” (rising time), and from “Full White” to “Full Black” (falling time), respectively. The response time is interval between the 10% and 90% of amplitudes. Please refer to the figure as below.



Note 5: Color chromaticity and coordinates (CIE) is measured by Minolta CA210

Note 6: Center luminance is measured by Minolta CA210

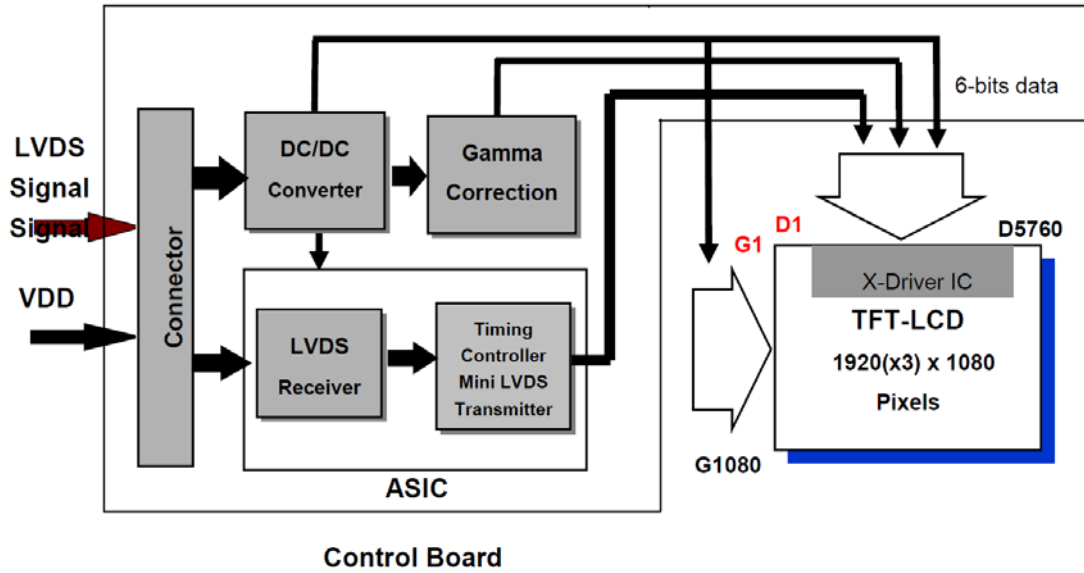
Note 7: Luminance uniformity of these 5 points is defined as below and measured by Minolta CA210



$$\text{Uniformity} = (\text{Min. Luminance of 5 points}) / (\text{Max. Luminance of 5 points})$$

3. Function block diagram

The following shows the block diagram of the 21.5 inch Color TFT-LCD Module.



4. Absolute Maximum Ratings

Absolute maximum ratings of the module are as following:

4.1 TFT LCD module

Items	Symbol	Min	Max	Unit	Conditions
Logic supply voltage	V _{DD}	GND-0.3	6.0	Volt	Note 1, 2

4.2 Backlight unit

Items	Symbol	Min	Max	Unit	Conditions
LED input current			840	mA	

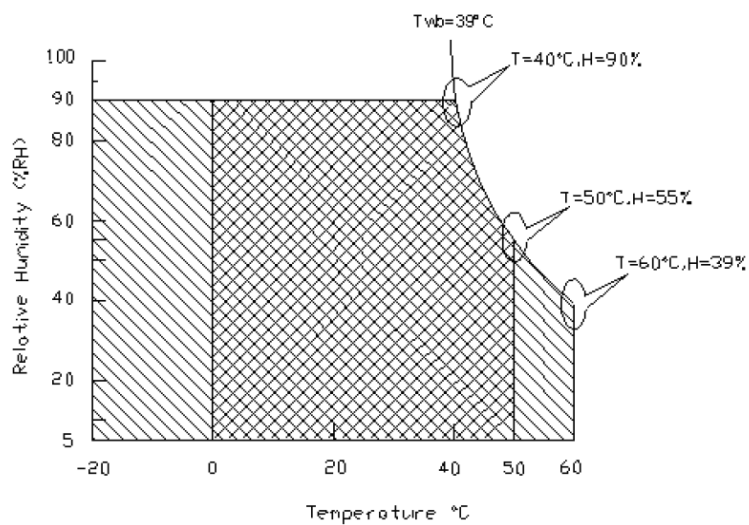
4.3 Environment

Items	Symbol	Values			Unit	Conditions
		Min.	Typ.	Max.		
Operation temperature	T _{OP}	-10	-	50	°C	Note 3
Operation Humidity	H _{OP}	10		85	%	
Storage temperature	T _{ST}	-20		60	°C	
Storage Humidity	H _{ST}	5		90	%	

Note 1: With in Ta= 25°C

Note 2: Permanent damage to the device may occur if exceed maximum values

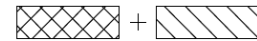
Note 3: For quality performance, please refer to IIS (Incoming Inspection Standard).



Operating Range



Storage Range



5. Electrical characteristics

5.1 TFT LCD module

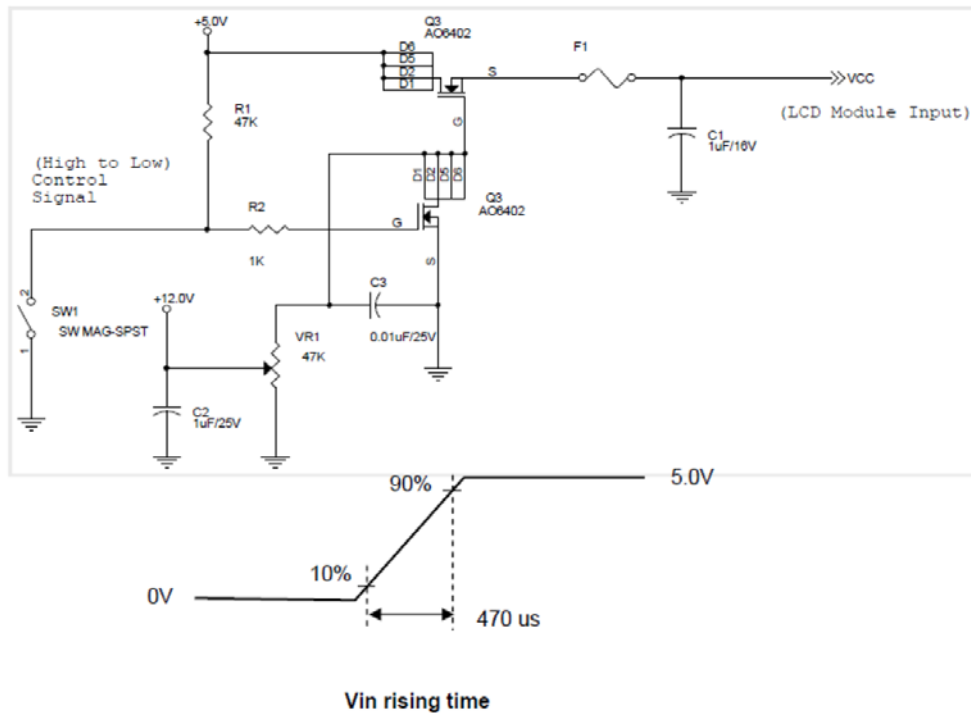
5.1.1 Power specification

Input power specifications are as follows

Symbol	Parameter	Min	Typ.	Max	Unit	Conditions
VDD	Logic/ LCD Drive Voltage	4.5	5	5.5	Volt	+/- 10%
IDD	Input current		0.7	0.84	A	VDD=5V, All black pattern. At 75Hz, +30%
PDD	VDD power		3.5	4.2	W	VDD=5V, All black pattern. At 75Hz,
IRush	Inrush current			3	A	Note 1
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			500	mV p-p	VDD=5V, All black pattern. At 75Hz,

Note 1: Measurement conditions:

The duration of rising time of input power is 470 us.



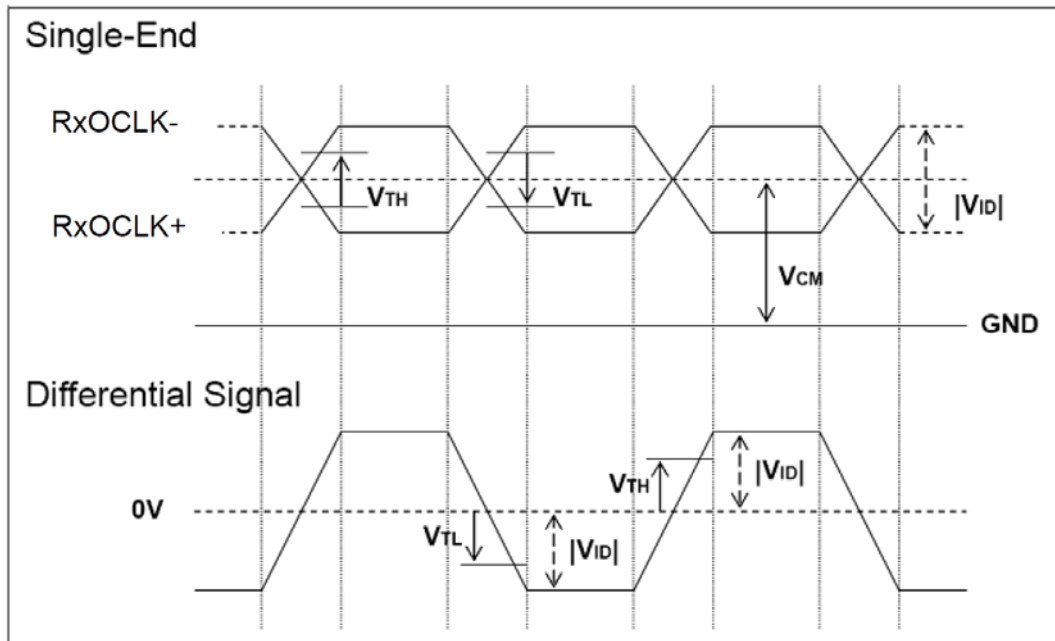
5.1.2 Signal electrical characteristics

a. DC Characteristics:

Symbol	Description	Min	Typ	Max	Units	Condition
V_{TH}	LVDS Differential Input High Threshold	-	-	+100	[mV]	$V_{CM} = 1.2V$
V_{TL}	LVDS Differential Input Low Threshold	-100	-	-	[mV]	$V_{CM} = 1.2V$
$ V_{ID} $	LVDS Differential Input Voltage	100	-	600	[mV]	
V_{CM}	LVDS Common Mode Voltage	+1.0	+1.2	+1.5	[V]	$V_{TH}-V_{TL} = 200mV$

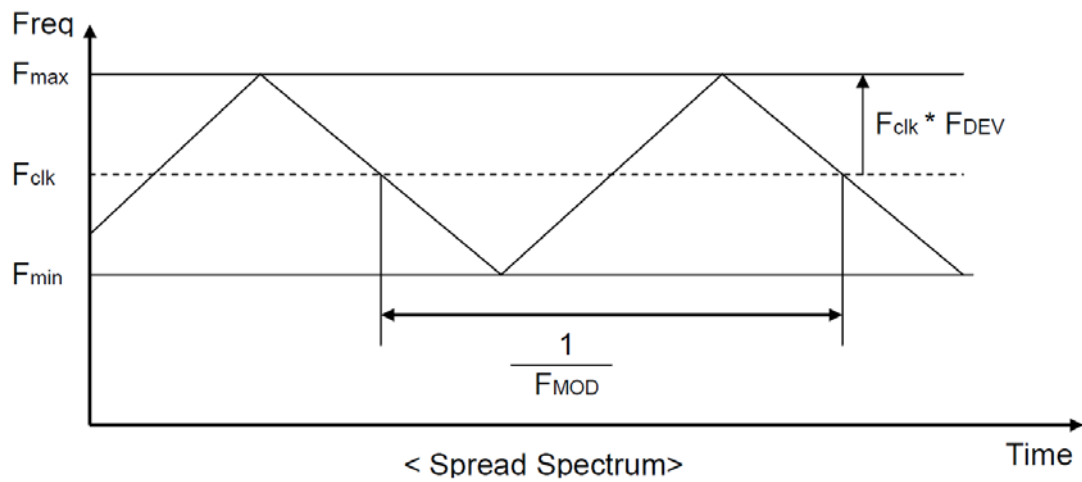
LVDS Signal Waveform:

Use RxOCLK- & RxOCLK+ as example.



b. AC Characteristics:

Symbol	Description	Min	Max	Unit	Remark
F_{DEV}	Maximum deviation of input clock frequency during Spread Spectrum	-	± 3	%	
F_{MOD}	Maximum modulation frequency of input clock during Spread Spectrum	-	200	KHz	



F_{clk}: LVDS Clock Frequency

5.2 Backlight unit

Parameter guideline is under stable conditions at 25°C (Room Temperature):

Parameter	Min	Typ	Max	Unit	Note
LED voltage (VL)		39		[V]	
LED current (IL)		400		[mA]	,
LED power consumption		31.2		W	2
LED Life Time(LTLED)		100,000		[Hour]	1

Note 1: The “LED lift time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and typical LED Current at 400 mA .

Note 2: Power consumption is VL x IL x 2

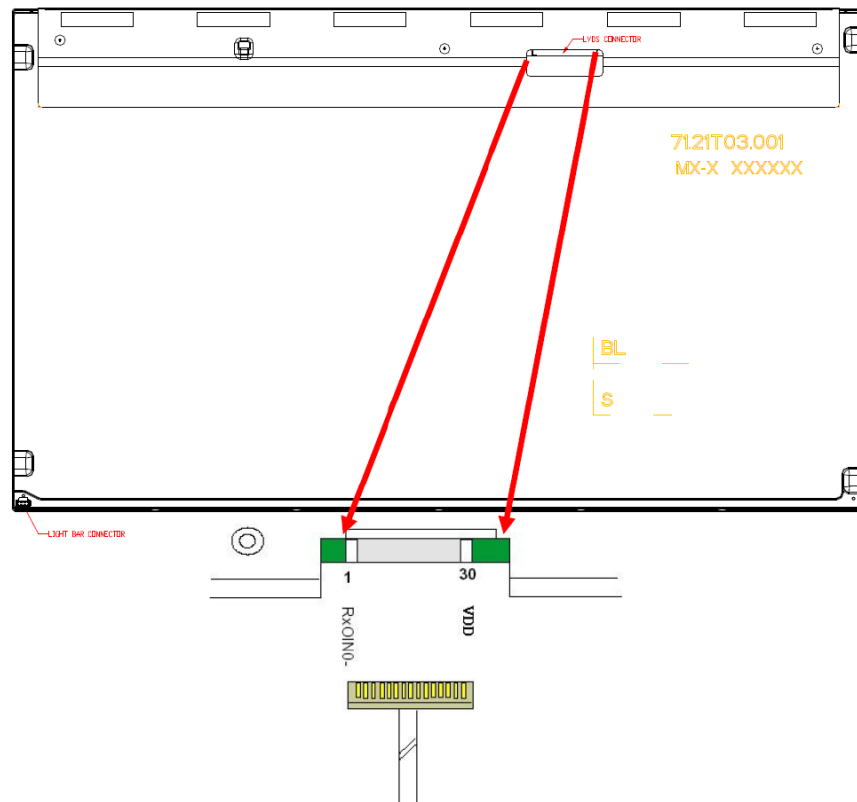
5.3 Interface connector

5.3.1 TFT connector(CN1)

The module using one LVDS receiver SN75LVDS82(Texas Instruments). LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling). The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

PIN#	Signal Name	DESCRIPTION
1	RxOIN0-	Negative LVDS differential data input (Odd data)
2	RxOIN0+	Positive LVDS differential data input (Odd data)
3	RxOIN1-	Negative LVDS differential data input (Odd data)
4	RxOIN1+	Positive LVDS differential data input (Odd data)
5	RxOIN2-	Negative LVDS differential data input (Odd data, DSPTMG)
6	RxOIN2+	Positive LVDS differential data input (Odd data, DSPTMG)
7	GND	Power Ground
8	RxOCLK-	Negative LVDS differential clock input (Odd clock)
9	RxOCLK+	Positive LVDS differential clock input (Odd clock)
10	RxOIN3-	Negative LVDS differential data input (Odd data)
11	RxOIN3+	Positive LVDS differential data input (Odd data)
12	RxEIN0-	Negative LVDS differential data input (Even data)
13	RxEIN0+	Positive LVDS differential data input (Even data)
14	GND	Power Ground
15	RxEIN1-	Negative LVDS differential data input (Even data)
16	RxEIN1+	Positive LVDS differential data input (Even data)
17	GND	Power Ground
18	RxEIN2-	Negative LVDS differential data input (Even data)
19	RxEIN2+	Positive LVDS differential data input (Even data)
20	RxECLK-	Negative LVDS differential clock input (Even clock)
21	RxECLK+	Positive LVDS differential clock input (Even clock)
22	RxEIN3-	Negative LVDS differential data input (Even data)
23	RxEIN3+	Positive LVDS differential data input (Even data)
24	GND	Power Ground
25	NC	Do not connect (for test only)
26	NC	Do not connect (for test only)
27	NC	Do not connect (for test only)
28	VDD	Power +5V
29	VDD	Power +5V
30	VDD	Power +5V

Note 1: Start from left side



Note2: Input signals of odd and even clock shall be the same timing.

5.3.2 Backlight connector(CN2)

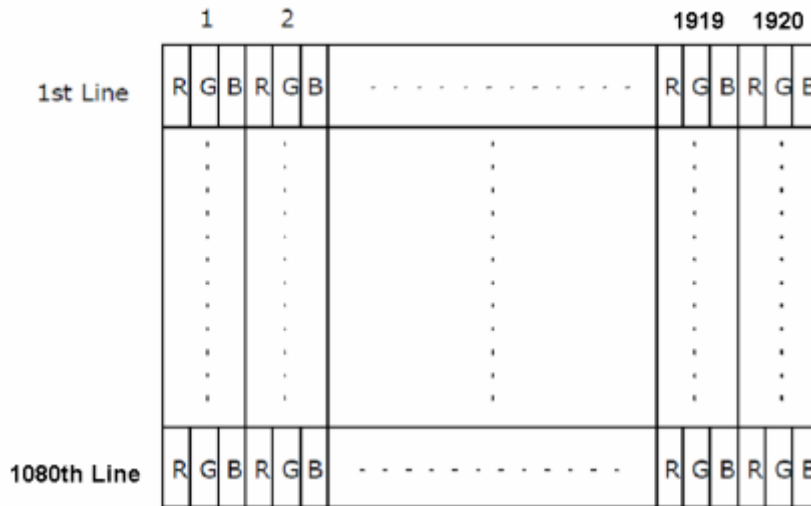
Pin No.	Symbol	I/O	Function	Remark
1	VLED+	P	Power for LED backlight anode	White
2	VLED-	P	Power for LED backlight cathode	Black

LED Light Bar Connector is used for the integral backlight system. The recommended model is BHSR-02VS-1 manufactured by JST.

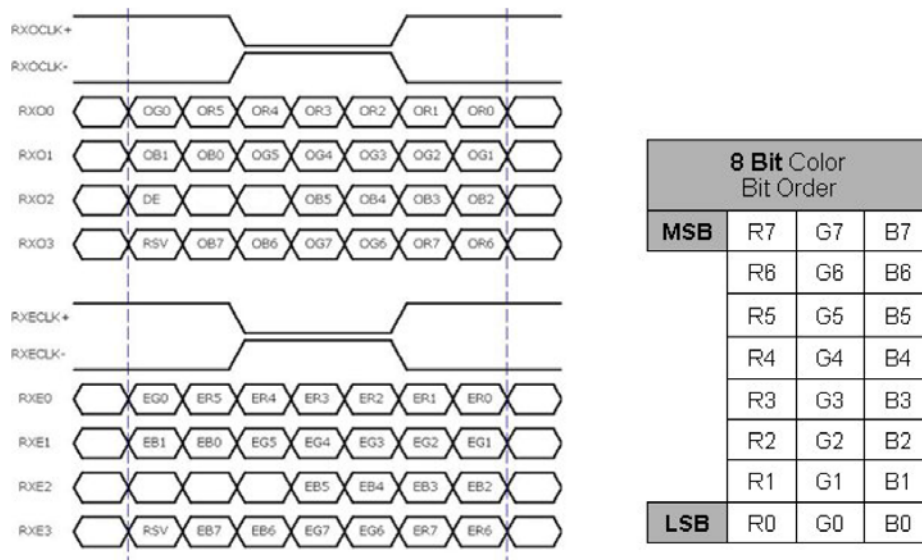
6. Signal characteristics

6.1 Pixel format image

Following figure shows the relationship of the input signals and LCD pixel format.



6.2 The input data format



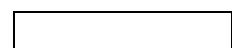
Note:

- a. O = "Odd Pixel Data" E = "Even Pixel Data"
- b. Refer to 3.4.1 LCD pixel format, the 1st data is 1 (Odd Pixel Data), the 2nd data is 2 (Even Pixel Data) and the last data is 1920 (Even Pixel Data).

6.3 Color versus input data

The following table is for color versus input data (8bit). The higher the gray level, the brighter the color.

Color	Gray Level	Color Input Data																				Remark				
		RED data (MSB:R7, LSB:R0)								GREEN data (MSB:G7, LSB:G0)								BLUE data (MSB:B7, LSB:B0)								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4		B3	B2	B1	B0
Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
White	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gray 127	-	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	
Red	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Green	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
Blue	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	L255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	



6.4 Input timing specification

It only support DE mode, and the input timing are shown as the following table.

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
Tv	Vertical Section	Period	1092	1130	1793	Th	Tv
Tdisp (v)		Active	1080	1080	1080	Th	Tdisp (v)
Tblk (v)		Blanking	12	50	713	Th	Tblk (v)
Fv		Frequency	50	60	76	Hz	Fv
Th	Horizontal Section	Period	1004	1050	1100	Tclk	Th
Tdisp (h)		Active	960	960	960	Tclk	Tdisp (h)
Tblk (h)		Blanking	44	90	140	Tclk	Tblk (h)
Fh		Frequency	55	68	90	KHz	Fh
Tclk	LVDS Clock	Period	11.1	14.0	18.2	ns	Tclk
Fclk		Frequency	54.8	71.2	90.0	MHz	Fclk

Note 1: The equation is listed as following. Please don't exceed the above recommended value.

$$Fh (Min.) = Fclk (Min.) / Th (Min.);$$

$$Fh (Typ.) = Fclk (Typ.) / Th (Typ.);$$

$$Fh (Max.) = Fclk (Max.) / Th (Min.);$$

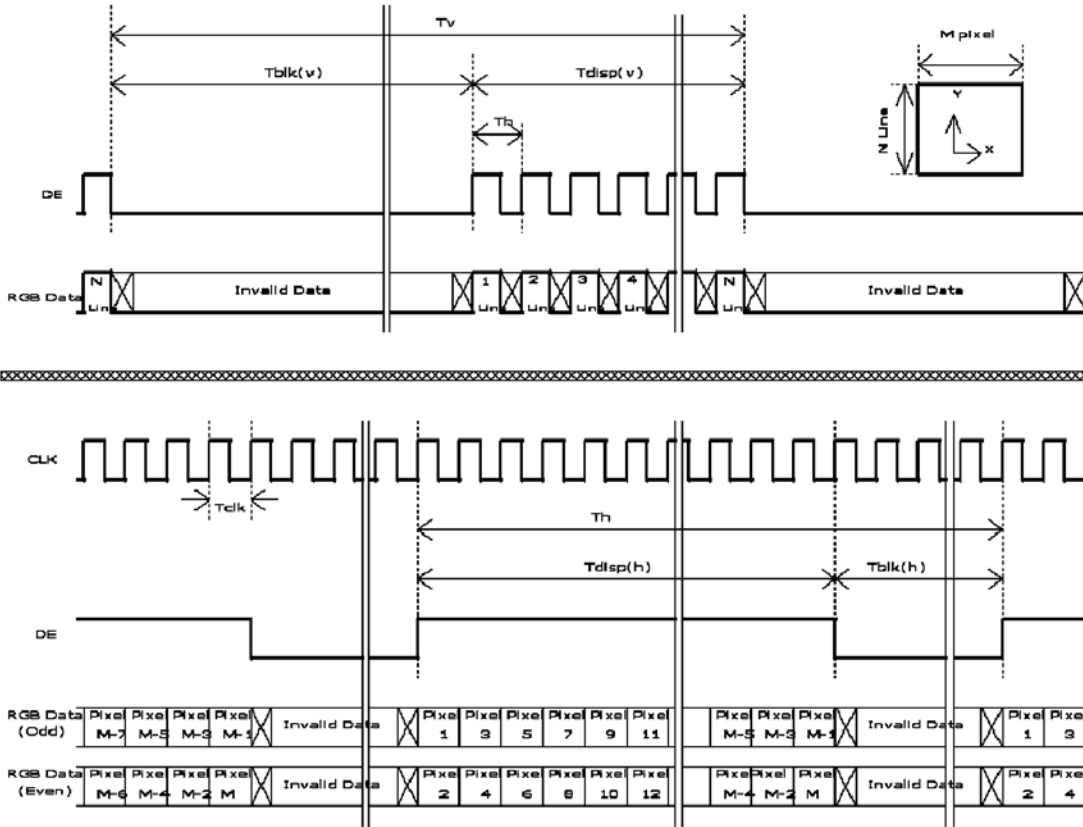
Note 2: The equation is listed as following. Please don't exceed the above recommended value.

$$Fclk (Min.) = Fv (Min.) \times Th (Min.) \times Tv (Min.);$$

$$Fclk (Typ.) = Fv (Typ.) \times Th (Typ.) \times Tv (Typ.);$$

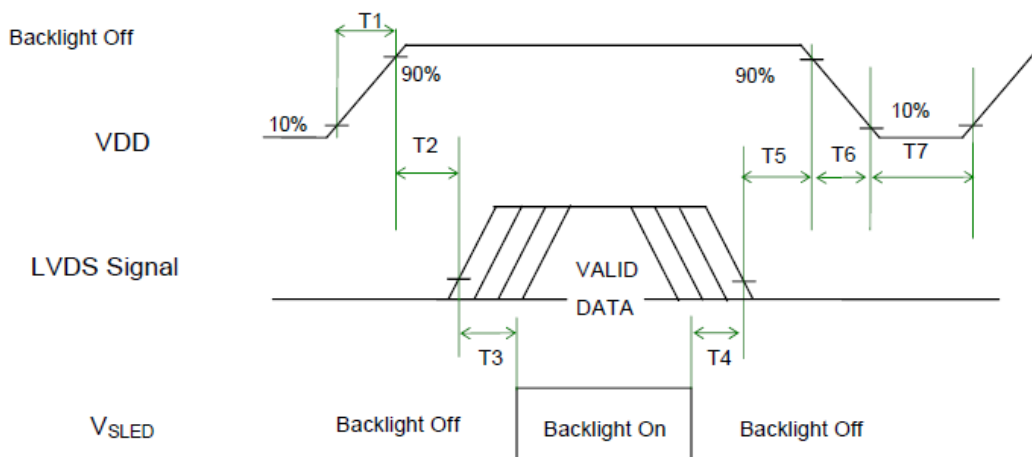
$$Fclk (Max.) = Fv (Max.) \times Th (Typ.) \times Tv (Typ.);$$

6.5 Input timing diagram



6.6 Power ON/OFF sequence

VDD power and lamp on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off.



Power Sequence Timing

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	[ms]	
T2	0	-	50	[ms]	
T3	500	-	-	[ms]	
T4	100	-	-	[ms]	
T5	0	-	50	[ms]	
T6	0	-	200	[ms]	
T7	1000	-	-	[ms]	

Note 3: Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

Note 4 : During T5 and T6 period , please keep the level of input LVDS signals with Hi-Z state.

Note 5 : Voltage of VDD must decay smoothly after power-off. (customer system decide this value)

7. Reliability Test

Environment test conditions are listed as following table.

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta=40°C, 80%RH, 240hours	
High Temperature Operation (HTO)	Ta= 50°C, 240hours	3
Low Temperature Operation (LTO)	Ta= -10°C, 240hours	
High Temperature Storage (HTS)	Ta= 60°C, 240hours	
Low Temperature Storage (LTS)	Ta= -20°C, 240hours	
Thermal Shock Test (TST)	-20°C/30min, 60°C/30min, 100 cycles	
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (ElectroStatic Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω) 1sec, 9 points, 25 times/ point.	
	Air Discharge: ± 15KV, 150pF(330Ω) 1sec 9 points, 25 times/ point.	

Note 1: The TFT-LCD module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -10°C to 50°C, and back again. Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

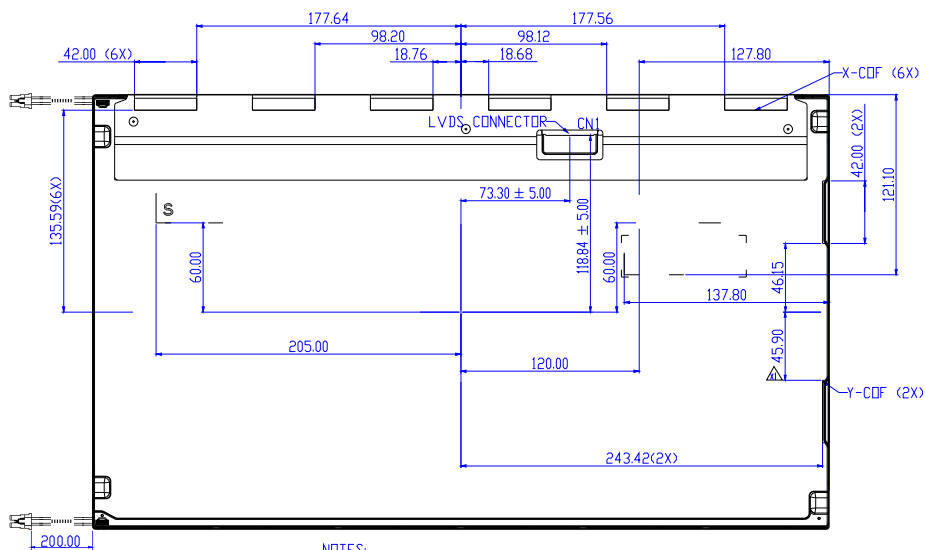
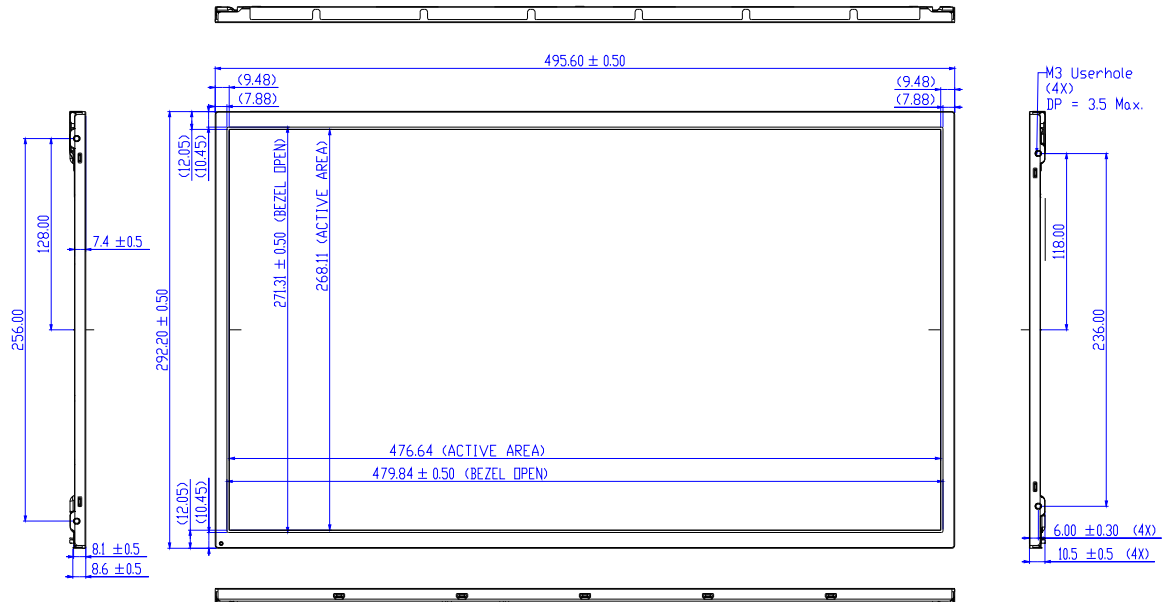
Note 2: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost. Self-recoverable. No hardware failures.

Note 3: TFT surface.

**8. Shipping package
(TBD)**



9. Mechanical Characteristics



- NOTES:
1. PRELIMINARY DRAWING FOR REFERENCE ONLY.
 2. THIS DIMENSION EXCLUDES DEFORMATION.
 3. BACKLIGHT: LED LIGHT-BAR (CN2)
 4. MODULE THICKNESS TO BE 11.1mm MAX.
 5. TOLERANCE WITHOUT SPECIFIED TO BE 0.5 mm.
 6. TORQUE OF M3 USER HOLE SHOULD BE WITHIN 4 KGF-CM AND RE-SCREW 10 TIMES.
 7. USER HOLE SCREW PENETRATION 3.5mm MAX.