Model name:ELM238A01 V1

M238HVN01.2

CUSTOMER APPROVE

APPROVED	CHECKED	PREPARED

Date	Rev.	Page	Old Description	New Description	Remark
2017.07.20	1.0	All	The specification was first issued		

1.0 GENERAL DESCRIPTION

1.1 OVERVIEW

M238HVN01.2 is a color active matrix TFT LCD open cell using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This open cell has a 23.6 inch diagonally measured active area with FHD resolutions (1920 horizontal by 1080 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors. The TFT-LCD panel used for this module is adapted for a low reflection and higher color type.

1.3 General Specifications

Item	Specifications	Unit	Note
Screen Diagonal	23.8 inch	[mm]	Note 1
Active Area	527.04 (H) ×296.46 (V)	[mm]	
Pixels H x V	1920(×RGB) × 1080		
Pixel Pitch	0.2745 ×0.2745	[mm]	
Pixel Arrangement	R.G.B. Vertical Stripe		
Display Mode	Normally Black		
Optical Response Time	20ms (Typ., on/off)	[msec]	
Nominal Input Voltage VDD	5.0V	[Volt]	
Power Consumption	14 watts Backlight+5.5watts Opencell (white pattern)	[Watt]	
Electrical Interface	LVDS		
Support Color	16.7M colors (6bit with FRC)		
Surface Treatment	Anti-Glare, Haze 25%,3H		

1.4 Mechanical Specification

Item		Min	Typ	Max	Unit	Note
Weight		-200	2100	+200	g	-
Module Size	Horizontal(H)	(TYP)-1.0	543.08	(TYP)+1.0	mm	1
	Vertical (V)		300.62		mm	
	Depth(D)		10.20		mm	

Note 1: Please refer to the"outline dimension" for more information of back and front outline dimensions.

2.0 Absolute Maximum Ratings

2.1 Abosolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Operating Temperature	TOP	0	+50	[oC]	Note 3
Glass surface temperature (operation)	TGS	0	+65	[oC]	Note 3, Note 4
Operation Humidity	HOP	5	90	[%RH]	
Storage Temperature	TST	-20	+60	[oC]	
Storage Humidity	HST	5	90	[%RH]	Note 3

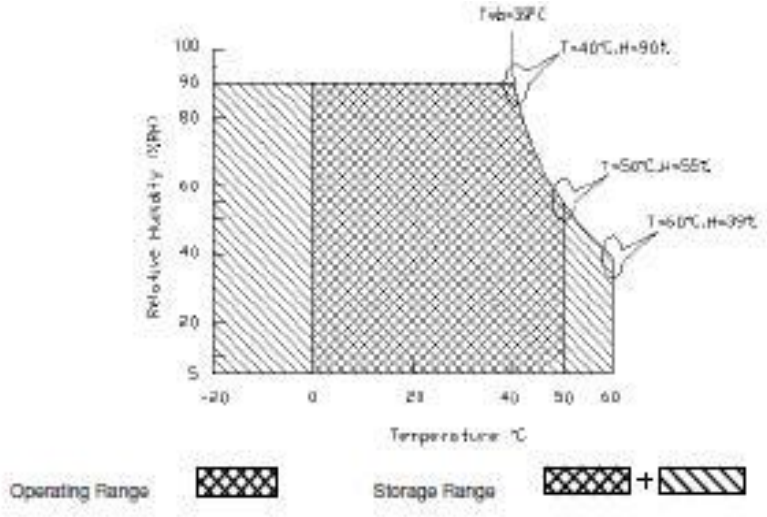
Note 1: With in Ta (25C)

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

Note 3: Temperature and relative humidity range are shown as the below figure.

1. 90% RH Max (≤39C)
2. Max wet-bulb temperature at

39 Note 4: Function Judged only



2.2 Backlight Unit

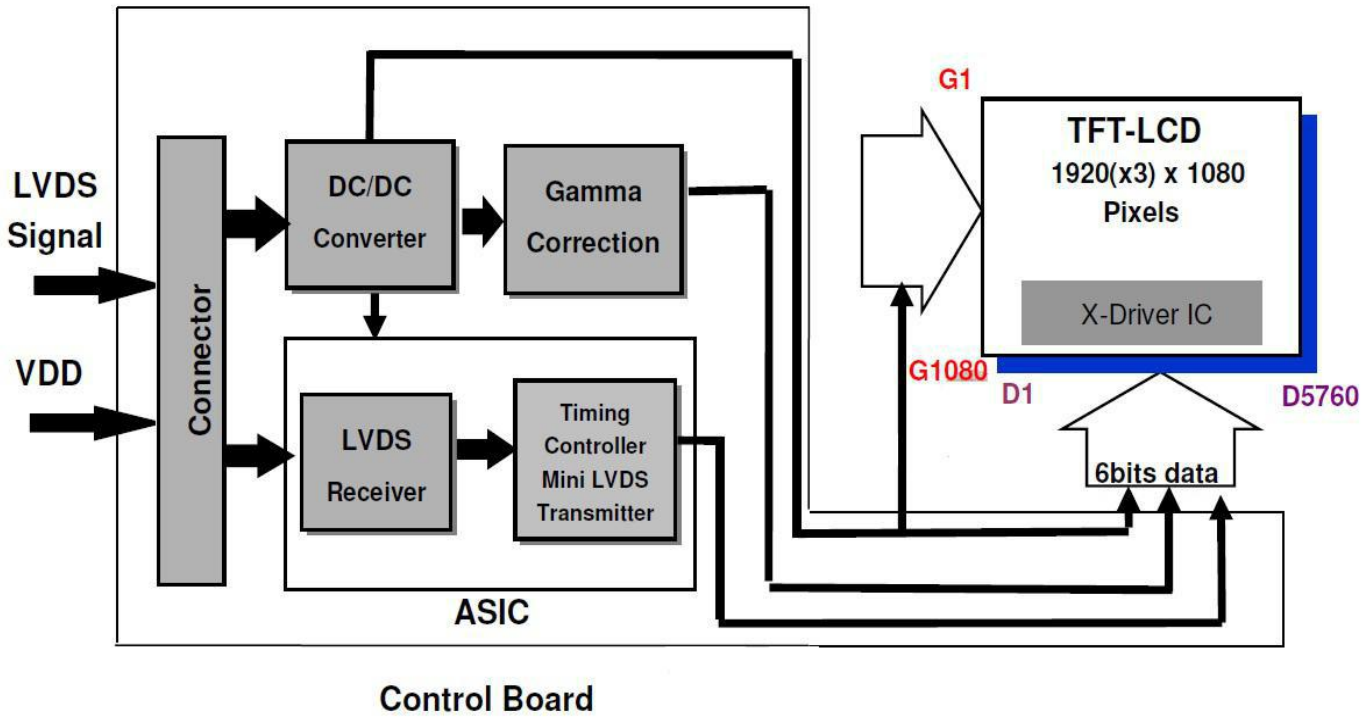
Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
LED operation Voltage	V_{led}	50.4	–	64.8	V_{led}	
LED operation Curent	I_{led}	–	240	–	mA	- (2)
BackLight Power	P_{BL}	12.00	–	15.55	W	(2)

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal operating Conditions.

3.0 TFT-LCD Module

3.1 Block Diagram

The following shows the block diagram of the 23.8 inch Color TFT-LCD Module.



3.2 Interface Connection

3.2.1 Connector Type

TFT-LCD Connector	Manufacturer	P-TWO	STM
	Part Number	187034-3009	MSCKT2407P30HB
Mating Connector	Manufacturer	JAE OR Compatible	
	Part Number	FI-X30HL(Locked Type) or Compatible	

PIN #	Symbol	DESCRIPTION	REMARK
1	RXO0-	Negative Transmission data of Pixel 0 (ODD)	
2	RXO0+	Positive Transmission data of Pixel 0 (ODD)	
3	RXO1-	Negative Transmission data of Pixel 1 (ODD)	
4	RXO1+	Positive Transmission data of Pixel 1 (ODD)	
5	RXO2-	Negative Transmission data of Pixel 2 (ODD)	
6	RXO2+	Positive Transmission data of Pixel 2 (ODD)	
7	GND	Power Ground	
8	RXOC-	Negative Transmission Clock (ODD)	
9	RXOC+	Positive Transmission Clock (ODD)	
10	RXO3-	Negative Transmission data of Pixel 3 (ODD)	
11	RXO3+	Positive Transmission data of Pixel 3 (ODD)	
12	RXE0-	Negative Transmission data of Pixel 0 (EVEN)	
13	RXE0+	Positive Transmission data of Pixel 0 (EVEN)	
14	GND	Power Ground	
15	RXE1-	Negative Transmission data of Pixel 1 (EVEN)	
16	RXE1+	Positive Transmission data of Pixel 1 (EVEN)	
17	GNG	Power Ground	
18	RXE2-	Negative Transmission data of Pixel 2 (EVEN)	
19	RXE2+	Positive Transmission data of Pixel 2 (EVEN)	
20	RXEC-	Negative Transmission Clock (EVEN)	
21	RXEC+	Positive Transmission Clock (EVEN)	
22	RXE3-	Negative Transmission data of Pixel 3 (EVEN)	
23	RXE3+	Positive Transmission data of Pixel 3 (EVEN)	
24	GND	Power Ground	Note1
25	NC	No connection(for AUO test only. Do not connect)	
26	NC	No connection(for AUO test only. Do not connect)	
27	NC	No connection(for AUO test only. Do not connect)	
28	VDD	Power Supply input Voltage +5V	
29	VDD	Power Supply input Voltage +5V	
30	VDD	Power Supply input Voltage +5V	

3.3 Backlight Electrical / Optical Characteristics

3.3.1 backlight connector

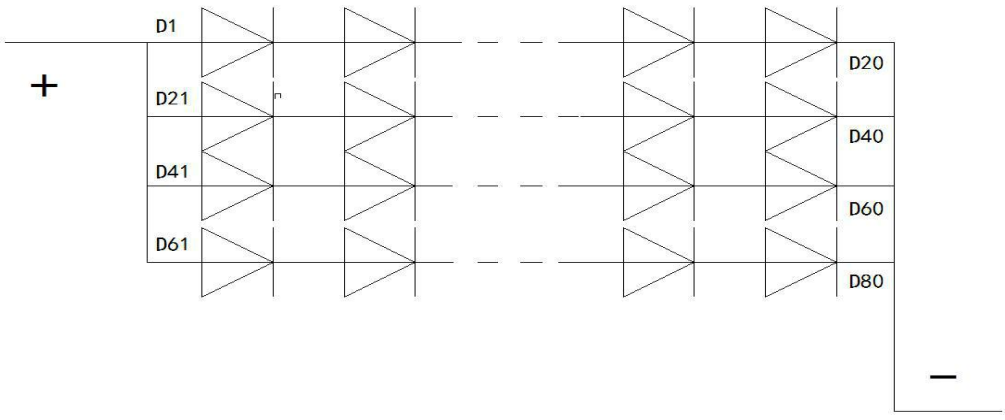
CN2 : PH 2.0 6P 01-000604-0175

Pin#	Signal Name
1	NC
2	NC
3	NC
4	VDD+
5	VDD-
6	NC

3.3.2 LED Bar

Parameter	Symbols	Min	Typ	Max	Unit
Forward Voltage (one circuit)	VF	2.8	-	3.6	MHz
Reverse Current (one circuit)	IR	-	-	10	μA
Forward Current	IF	-	60	100	Ma
Chromaticity Coordinates	X	0.247	0.267	0.287	
	Y	0.222	0.242	0.262	
Lumen	¢	20	22	24	LM
Viewing Angle	2θ1/2	-	16.7	13.3	Deg.
Number Of LED	Pcs	-	80	-	Pcs
Operation Voltage(LB)	VLB	56	-	68	V
Operation Current(LB)	ILB	-	240	-	mA
Power Consumption	PLB	13.44	-	16.32	W

3.3.3 Arry Mode Of LED Bar



3.4 Electrical Characteristics

3.4.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

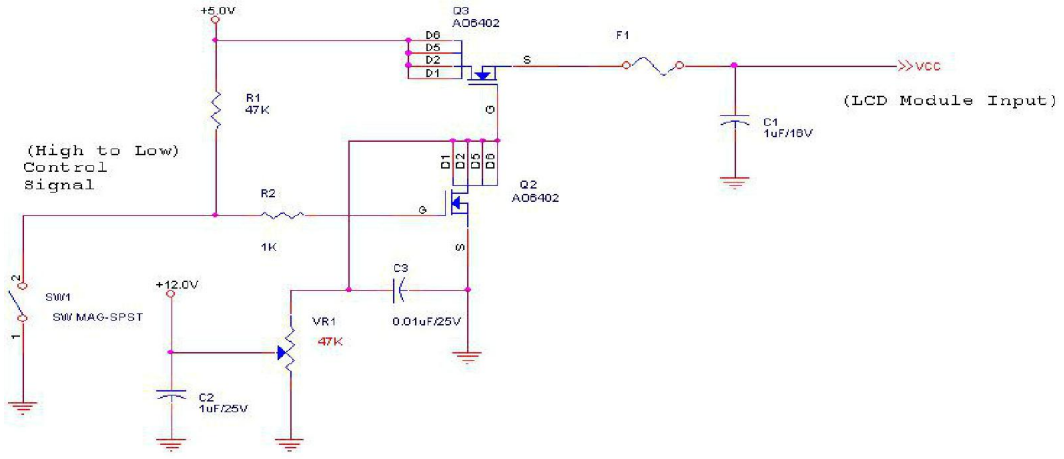
Symbol	Description	Min	Max	Unit	Remark
VDD	Power Supply Input Voltage	GND-0.3	6.0	[Volt]	Ta=25℃

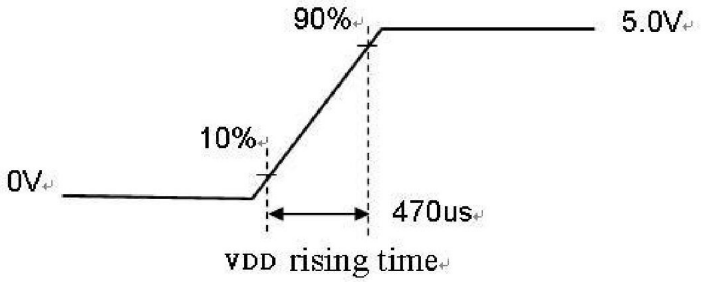
3.4.2 Recommended Operating Condition

Symbol	Description	Min	Typ	Max	Unit	Remark
VDD	Power Supply Input Voltage	4.5	5	5.5	[Volt]	
IDD	Power Supply Input Voltage	-	1	1.2	[A]	VDD= 5.0V, All white Pattern , Fv=60Hz
		-	1.1	1.4		VDD= 5.0V, All white Pattern , Fv=75Hz
PDD	Power Supply Input Voltage	-	5	6	[A]	VDD= 5.0V, All white Pattern , Fv=60Hz
		-	5.5	6.6		VDD= 5.0V, All white Pattern , Fv=75Hz
Irush	Power Supply Input Voltage	-	-	3	[Watt]	Ta=25℃
VDDrp	Power Supply Input Voltage	-	-	500	[Watt]	VDD= 5.0V, All white Pattern , Fv=75Hz

Note 3-1: Inrush Current measurement:

Test circuit:

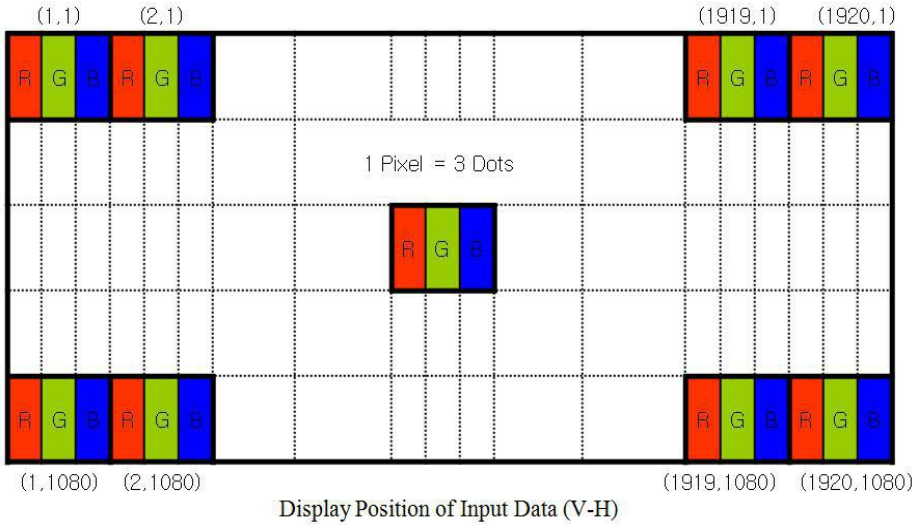




The duration of VDD rising time: 470us.

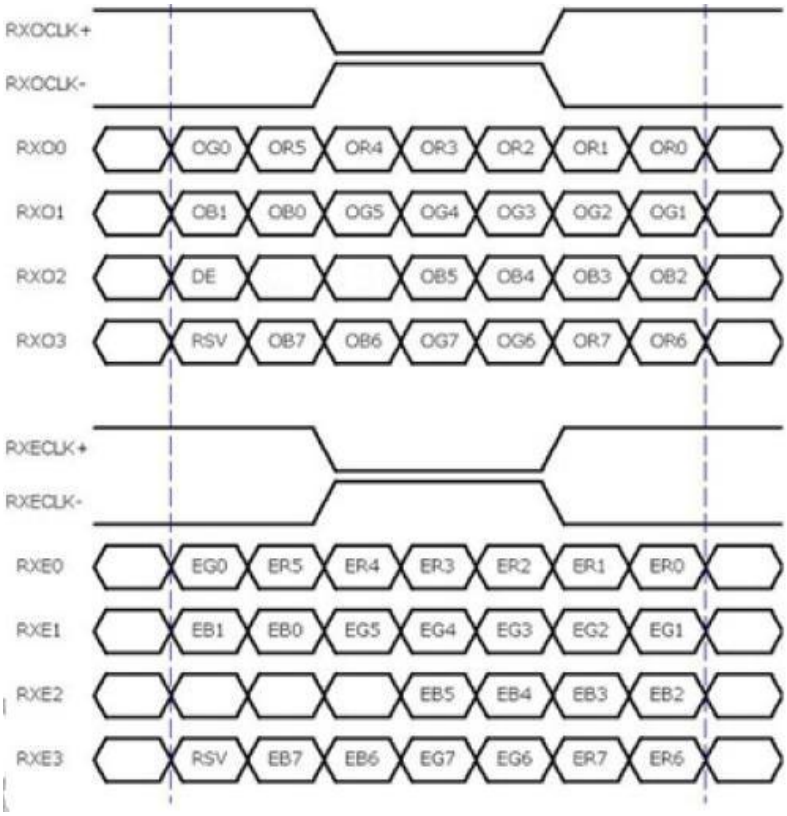
4.0 Signal Characteristics

4.1 LCD Pixel Format



Display Position of Input Data (V-H)

4.2 LVDS Data Format



8 Bit Color Bit Order			
MSB	R7	G7	B7
	R6	G6	B6
	R5	G5	B5
	R4	G4	B4
	R3	G3	B3
	R2	G2	B2
	R1	G1	B1
LSB	R0	G0	B0

Note 4-2:

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).

4.3 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	1	1	1	1	1	1	1	1	0	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	1	1	1	1	1	1	1	1	

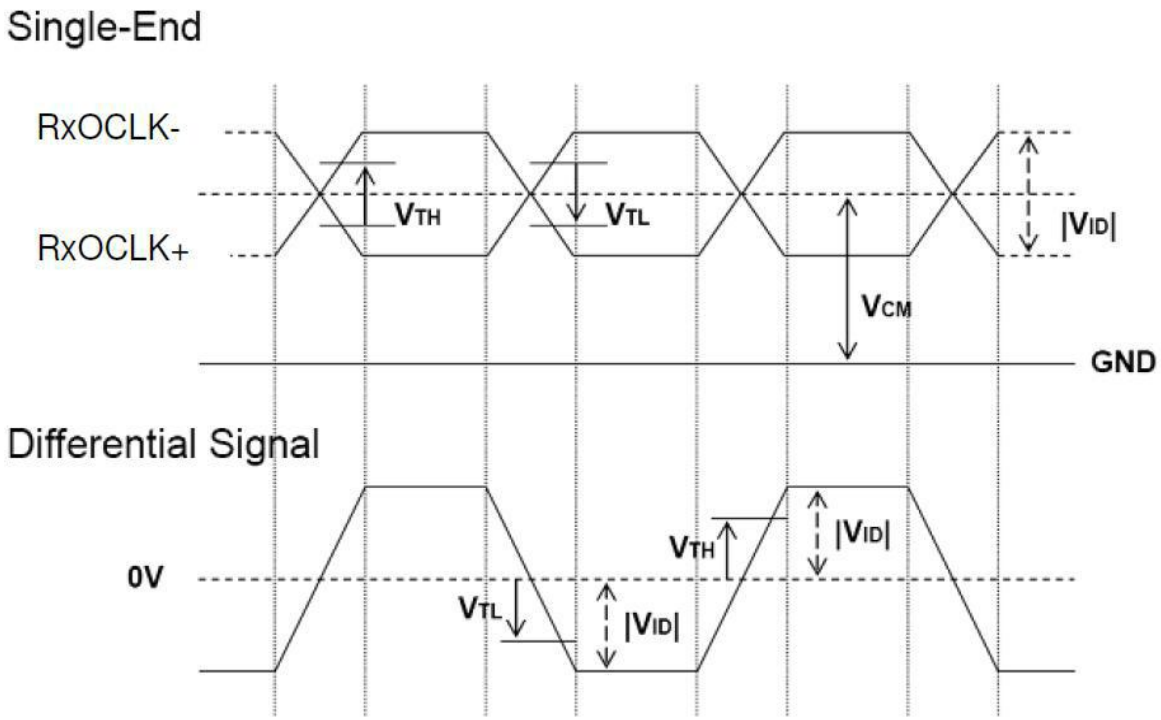
4.4 LVDS Specification a.

DC Characteristics:

Symbol	Description	Min	Typ	Max	Unit	Remark
VTH	LVDS Differential Input High Threshold	-	-	+100	[mV]	VCM = 1.2V
VTL	LVDS Differential Input Low Threshold	-100	-	-	[mV]	VCM = 1.2V
|VID|	LVDS Differential Input Voltage	100	-	600	[mV]	
VCM	LVDS Common Mode Voltage	+1.0	+1.2	+1.5	[V]	VTH-VTL = 200mV

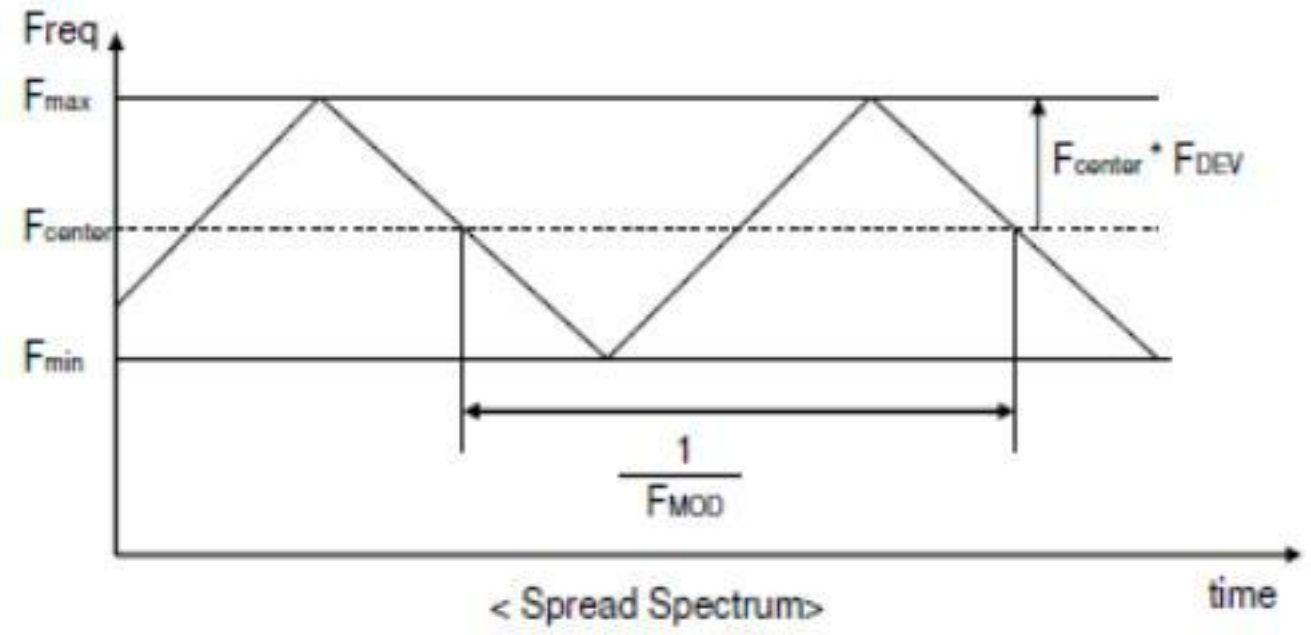
LVDS Signal Waveform:

Use RxOCLK- & RxOCLK+ as example.



b. AC Characteristics:

Symbol	Description	Min	Max	Unit	Remark
FDEV	Maximum deviation of input clock frequency during Spread Spectrum	-	±3	%	
FMOD	Maximum modulation frequency of input clock during Spread Spectrum	-	200	KHZ	



Fclk: LVDS Clock Frequency

5.0 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	1094	1130	1836	Th	
Tdisp (v)		Active	1080	1080	1080	Th	
Tblk (v)		Blanking	14	50	756	Th	
Fv		Frequency	49	60	76	Hz	
Th	Horizontal Section	Period	1000	1050	1678	Tclk	
Tdisp (h)		Active	960	960	960	Tclk	
Tblk (h)		Blanking	40	90	718	Tclk	
Fh		Frequency	53.7	67.8	90	KHz	Note 5-1
Tclk	LVDS Clock	Period	11.2	14	18.6	ns	1/Fclk
Fclk		Frequency	53.7	71.2	90	MHz	Note 5-2

Note 5-1: 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.);

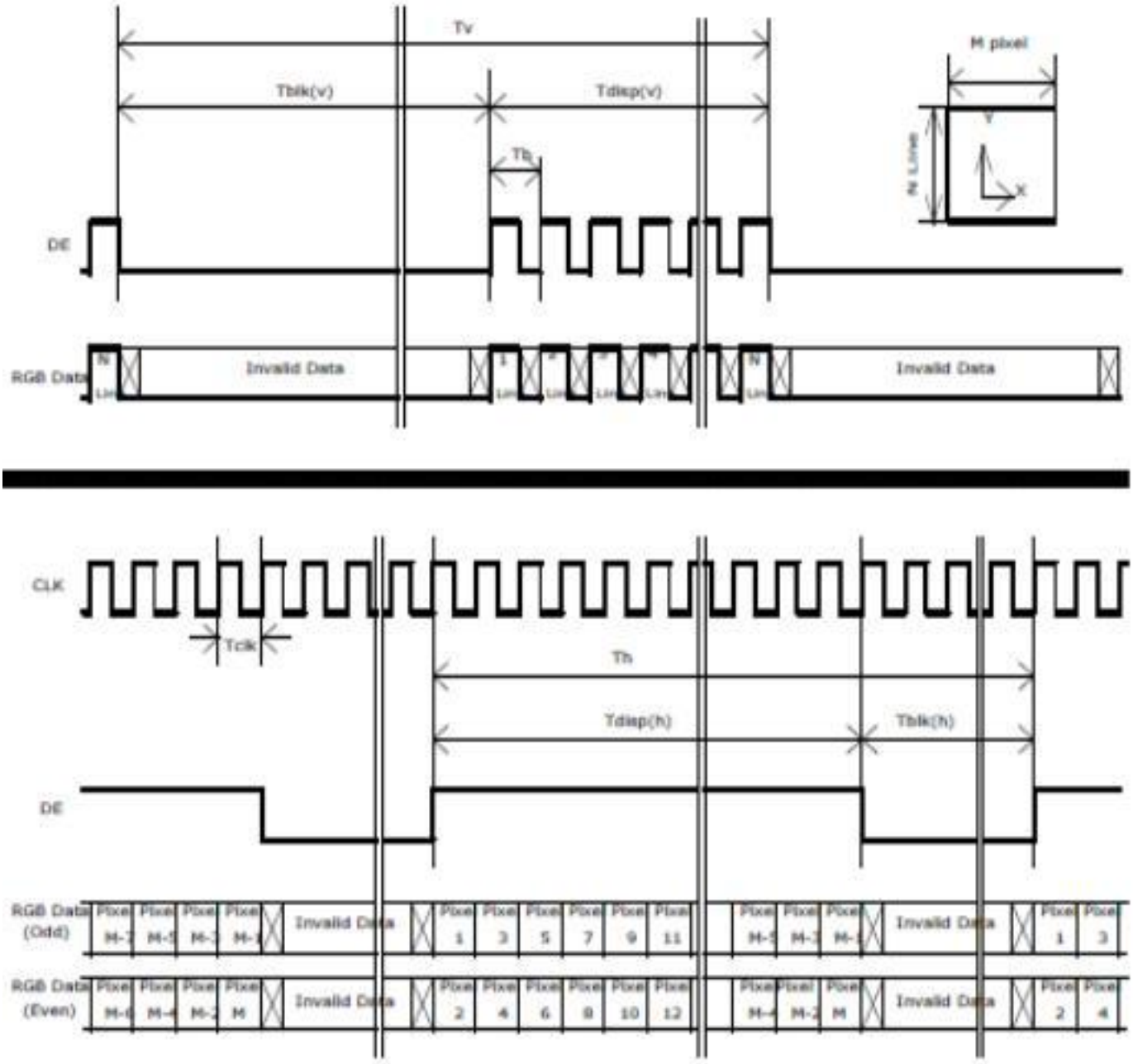
Note 5-2: The equation is listed as following. Please don't exceed the above recommended value.

Fclk (Min.) = Fv (Min.) x Th (Min.) x Tv (Min.);

Fclk (Typ.) = Fv (Typ.) x Th (Typ.) x Tv (Typ.);

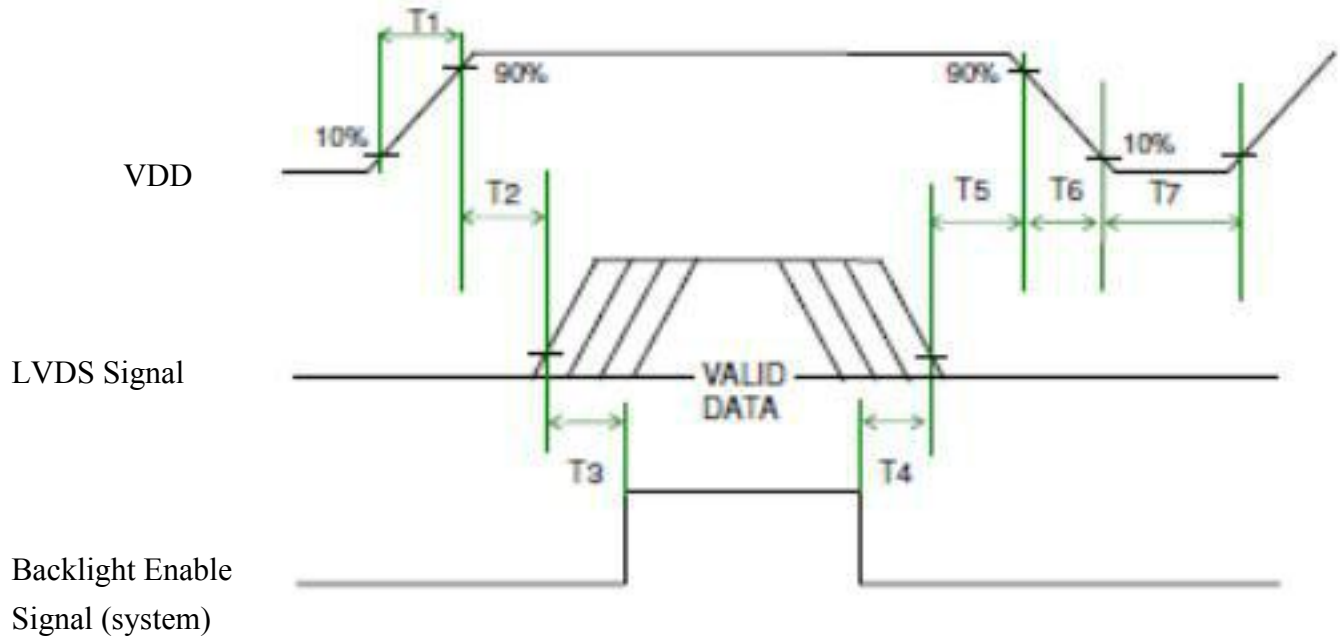
Fclk (Max.) = Fv (Max.) x Th (Typ.) x Tv (Typ.);

5.1 Input Timing Diagram



6.0 Power ON/OFF Sequence.0 POWER SEQUENCE

VDD power,LVDS signal and backlight on/off sequence are as following. LVDS signals from any system shall be Hi-Z state when VDD is off.



Power Sequence Timing

Parameter	Value			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	[ms]
T2	0	-	50	[ms]
T3	500	-	-	[ms]
T4	100	-	-	[ms]
T5	0	-	50	[ms] Note1,2
T7	1000	-	-	[ms]

Note 6-1 : Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

Note 6-2 : During T5 period , please keep the level of input LVDS signals with Hi-Z state.

7.0 Optical Characteristics

7.1 Test Condition

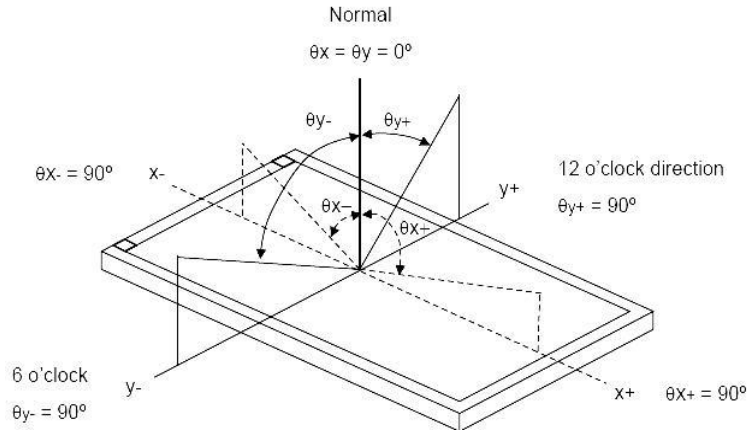
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25 ± 2	℃
Ambient Humidity	Ha	50 ± 10	%RH
Supply Voltage	Vcc	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Input Voltage	V_{LED}	61.2	V
LED Input Curent	I_{LED}	240.0	mA
Power Consumption	Pw	14.7	W

7.2 Optical Characteristics

The relative measurement methods of optical characteristics are shown as below.
The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θx=0,θy=0, viewing normal angle	700	1000	—	—	—
Response Time		Tr+Tf		—	14	20	ms	Note 3
Brightness unformity		BU		70	75	—	—	Note 2
Center Luminance of White		Lc		200	250	—	cd/m2	—
The color chromaticity	Red	Rx		Typ. -0.03	0.653	Typ. +0.03	—	—
		Ry			0.326		—	—
	Green	Gx			0.272		—	—
		Gy			0.587		—	—
	Blue	Bx			0.150		—	—
		By			0.086		—	—
	White	Wx			0.290		—	—
		Wy			0.300		—	—
Viewing Angle	Horizental	θx+	CR≧10	85	89	—	Deg	Note 1
		θx-		85	89	—		
	Vertical	θy+		85	89	—		
		θy-		85	89	—		

Note 1: The definition of viewing angle



ote 2: Definition of luminance , CR measured positions and brightness uniformity

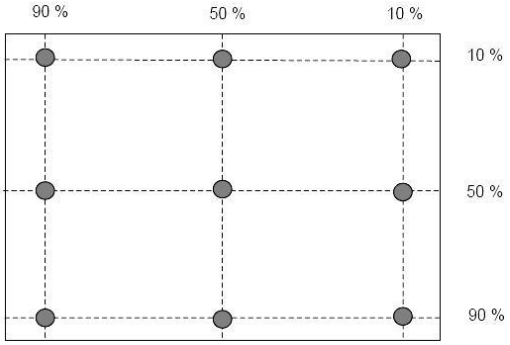
(a) Measure White luminance on the below 9 points and take the average value .

(b) CR : measures the same 9 points and take the average value .The Definition of Contrast Ratio is as folows :

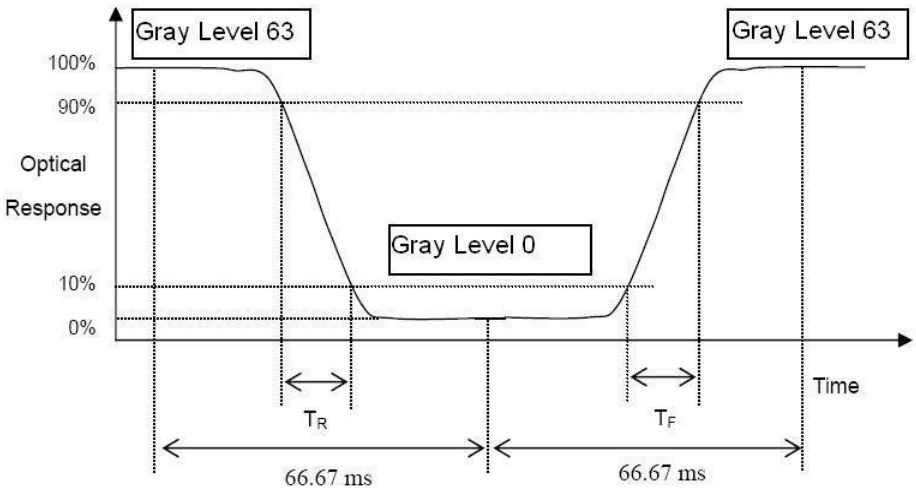
CR = ON(white L63)Luninance / OFF (Black L0)Luminance

(c) The definition of White Vibration

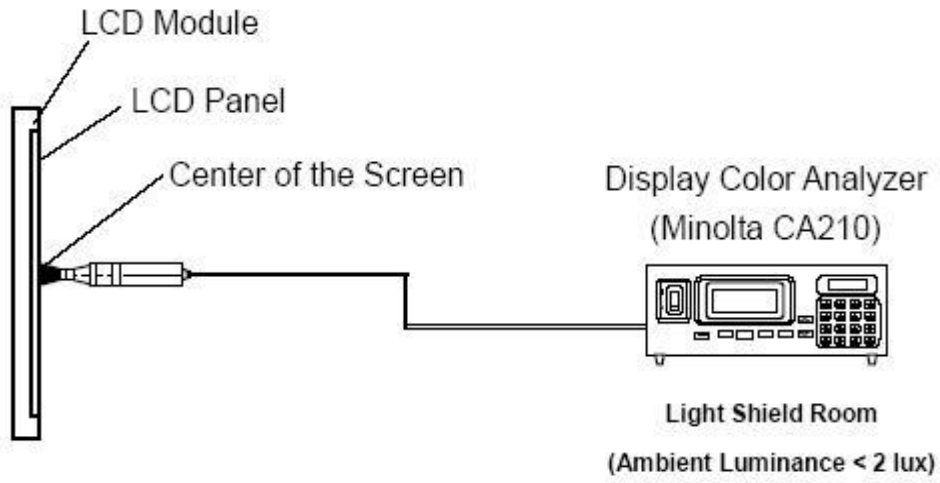
$$\frac{\text{The minimum brightness of 9 dot}}{\text{The maximum brightness of 9 dot}} \times 100\%$$



Note 3:Definition of Response Time (TR, TF):



Note 4: The measure method



(a): The measurement point is the center of the active area except for the measurement of Luminance Uniformity

(b): Photometer :CA-210

8.0 Reliability Test

Environment test conditions are listed as following table.

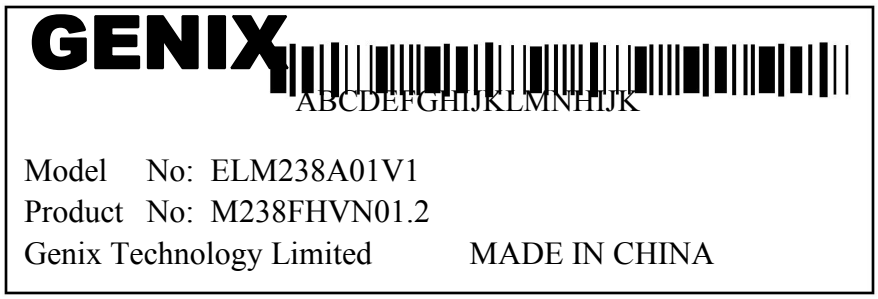
Items	Required Condition	Note
Temperature Humidity Bias (THB	Ta= 50℃， 80%RH, 300hours	
High Temperature Operation (HTO	Ta= 50℃， 50%RH, 300hours	
Low Temperature Operation (LTO	Ta= 0℃， 300hours	
High Temperature Storage (HTS)	Ta= 60℃， 300hours	
Low Temperature Storage (LTS)	Ta= -20℃， 300hours	
Vibration Test (Non-operation)	Acceleration: 1.5 Grms Wave: Random Frequency: 10 - 200 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	
Shock Test (Non-operation)	Wave: Half-sine Active Time: 20 ms Direction:±X,±Y,±Z(one time for each Axis)	
Drop Test	Height: 60 cm, package test	
Thermal Shock Test (TST)	-20℃/30min, 60℃/30min, 100 cycles	1
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: ± 8KV, 150pF(330) 1sec, 8 points, 25 times/ point. Air Discharge: ± 15KV, 150pF(330) 1sec 8 points, 25 times/ point.	2
Altitude Test	Operation:18,000 ft Non-Operation:40,000 ft	

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 -20℃ to 60℃, 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: EN61000-4-2, ESD class B: Certain performance degradation
allowed No data lost
Self-recoverable
No hardware failures.

9.0 Shipping Label

9.1Panel Label



9.2 Caution Label

10. Packaging

(TBD)

Note 1) Acceptable number of piling : 5 sets

11.0 PRECAUTION

11.1 ASSEMBLY AND HANDLING PRECAUTIONS

1 Do not apply rough force such as bending or twisting to the module during assembly.
2 To assemble or install module into user's system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
3 It's not permitted to have pressure or impulse on the module because the LCD panel and Bac-klight will will be damaged.
4 Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
5 Do not pull the I/F connector in or out while the module is operating .
6 Do not disassemble the module.
Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very 7 soft and easily scratched.
8 It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
9 High temperature or humidity may reduce the performance of module. Please store LCD mo-dule within the specified storaged conditions.
10 When ambient temperature is lower than 10 ℃ may reduce the display quality. For example, the response time will become slowly.

11.2 SAFETY PRECAUTIONS

1 It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
2 If the liquid crystal material leaks from the panel,it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
3 After the modlule's end of life, it is not harmful in case of normal operation and storage.