HM215FH101A-PT

21.5" Color TFT-LCD with
Multi-Point Projected Touch Screen

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1. General Description

This specification applies to the 21.5 inchwide Color a-Si TFT-LCD Module HM215FH101A-PT The display supports the Full HD - 1920(H) x 1080(V) screen format and 16.7M colors (8 bits RGB data input). The input interface is Dual channel LVDS and this module doesn't contain a driver board for backlights.

*** General Information**

1.1 Display Characteristics

The following items are characteristics summary on the table under 25□ condition:

ITEMS	Unit	SPECIFICATIONS
Screen Diagonal	[mm]	546.86(21.5")
Active Area	[mm]	476.64 (H) x 268.11 (V)
Pixels H x V	-	1920(x3) x 1080
Pixel Pitch	[um]	248.25 (per one triad) ×248.25
Pixel Arrangement	-	R.G.B. Vertical Stripe
Display Mode	-	VA Mode, Normally Black
White Luminance (Center)	[cd/m2]	200 (Typ.)
Contrast Ratio	-	3000 (Typ.)
Response Time	[msec]	18ms (Typ., on/off) at surface 35 degree C
Power Consumption (LCD Module + Backlight unit)	[Watt]	15.2 (Typ.) LCD module : PDD (Typ.)= 3.1 @ all white pattern=60Hz Backlight unit : PBLU (Typ.) =12.1 @Is=65mA
Weight	[Grams]	1670
Outline Dimension	[mm]	495.6(H) × 292.2(V) Typ.
Electrical Interface	-	Dual channel LVDS, 8 bits RGB data input
Support Color	-	16.7M colors
Surface Treatment	-	Anti-Glare, 3H
Temperature Range Operating Storage (Shipping)	 [°C] [°C]	 -10 to +50 -20 to +60
RoHS Compliance	-	RoHS Compliance
TCO Compliance	-	TCO 6.0 Compliance
Touch Screen Type	-	Projected Capacitive Touch (10 Point Touch)
Touch Screen Interface	-	USB

1.2 Optical Characteristics

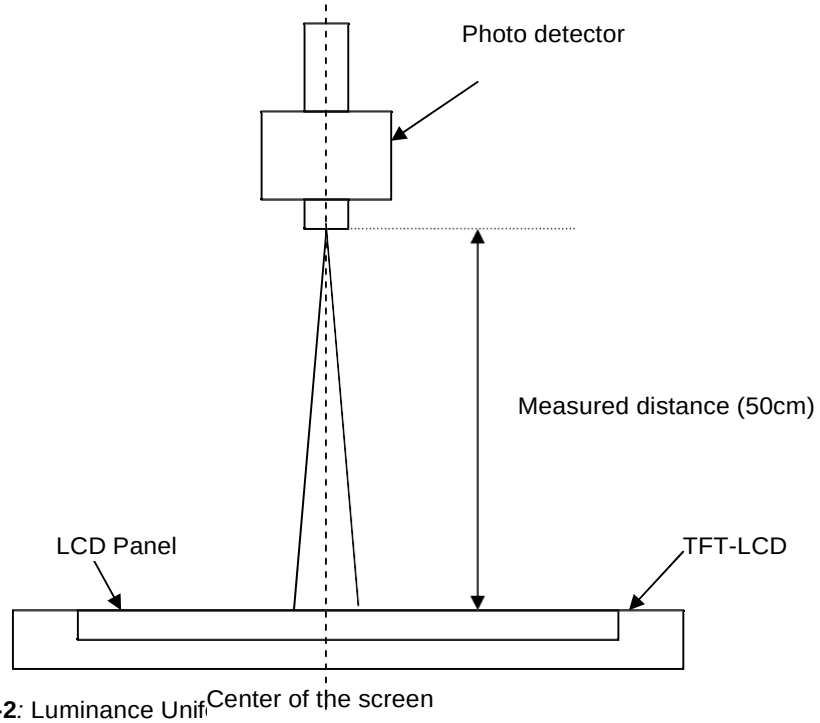
The optical characteristics are measured on the following test condition.

Test Condition:

1. Equipment setup: Please refer to Note 1-1.
2. Panel Lighting time: 30 minutes
3. VDD=5.0V, Fv=60Hz,Is=65mA,Ta=25℃

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
Lw	White Luminance (Center of screen)		180	200	-	[cd/m2]	Note 1-1
Luni	Luminance Uniformity (9 points)		75	80	-	[%]	Note 1-2
CR	Contrast Ratio (Center of screen)		2000	3000	-	-	Note 1-3
θR	Horizontal Viewing Angle (CR=10)	Right	75	89	-	[degree]	Note 1-4
θL		Left	75	89	-		
ΦH	Vertical Viewing Angle (CR=10)	Up	75	89	-		
ΦL		Down	75	89	-		
θR	Horizontal Viewing Angle (CR=5)	Right	75	89	-		
θL		Left	75	89	-		
ΦH	Vertical Viewing Angle (CR=5)	Up	75	89	-		
ΦL		Down	75	89	-		
TR	Response Time	Rising Time	-	13	28	[msec]	Note 1-5
TF		Falling Time	-	5	8		
-		Rising + Falling	-	18	36		
Rx	Color Coordinates (CIE 1931)	Red x	0.622	0.652	0.682	-	
Ry		Red y	0.305	0.335	0.365		
Gx		Green x	0.291	0.321	0.351		
Gy		Green y	0.595	0.625	0.655		
Bx		Blue x	0.123	0.153	0.183		
By		Blue y	0.037	0.067	0.097		
Wx		White x	0.283	0.313	0.343		
Wy		White y	0.299	0.329	0.359		
NTSC Area Ratio				72		[%]	
CT	Crosstalk		-	-	2.0	[%]	Note 1-6
FdB	Flicker (Center of screen)		-	-	-20	[dB]	Note 1-7

Note 1-1: Equipment setup :

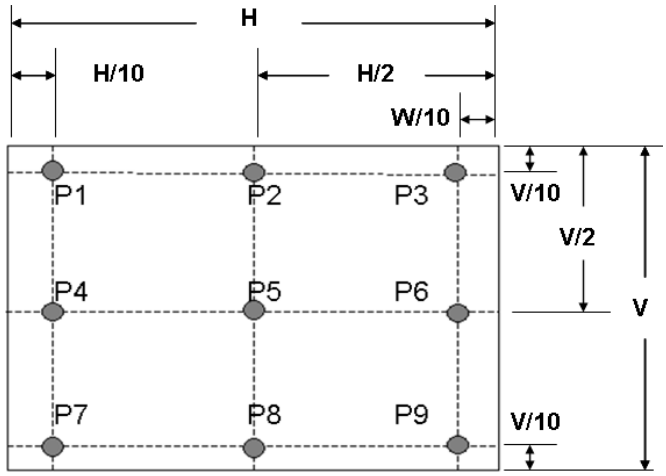


Note 1-2*:* Luminance Unif

Definition:

$$\text{Luminance Uniformity} = \frac{\text{Minimum Luminance of 9 Points (P1 ~ P9)}}{\text{Maximum Luminance of 9 Points (P1 ~ P9)}}$$

a. Test pattern: White Pattern



Note 1-3: Contrast Ratio Measurement

Definition:

$$\text{Contrast Ratio} = \frac{\text{Luminance of White pattern}}{\text{Luminance of Black pattern}}$$

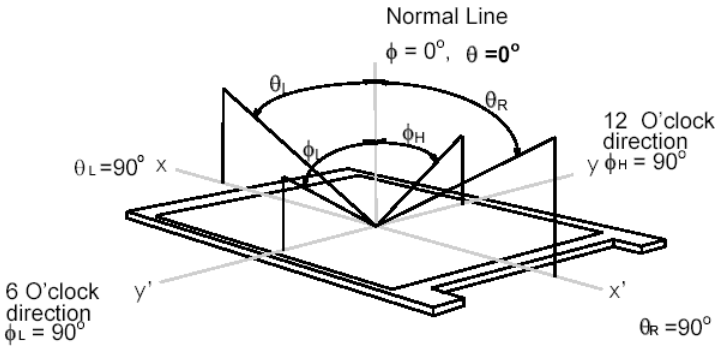
a. Measured position: Center of screen (P5) & perpendicular to the screen (θ=Φ=0°)

Note 1-4: Viewing angle measurement

Definition: The angle at which the contrast ratio is greater than 10 & 5 .

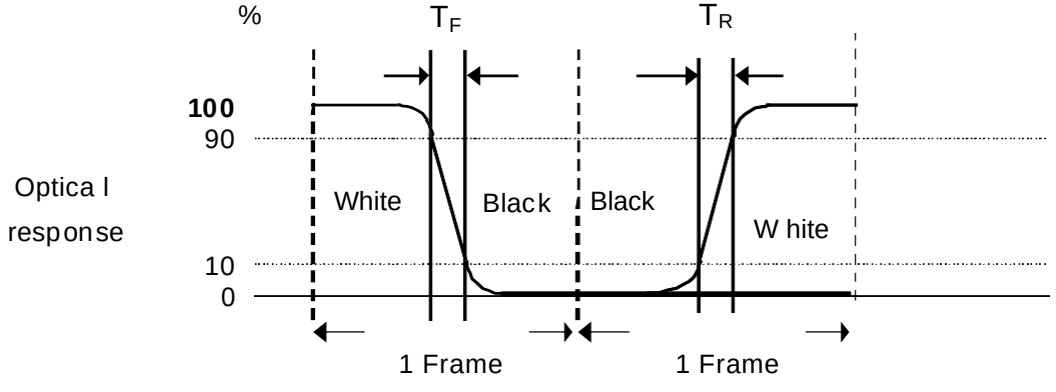
a. Horizontal view angle: Divide to left & right (θL & θR)

Vertical view angle: Divide to up & down (ΦH &ΦL)



Note 1-5: Response time measurement

The output signals of photo detector are measured when the input signals are changed from “Black” to “White” (rising time, TR), and from “White” to “Black” (falling time, TF), respectively. The response time is interval between the 10% and 90% of optical response. (Black & White color definition: Please refer section 3.4.3)



Note 1-6: Crosstalk measurement

Definition:

CT = Max. (CTH,CTV);

Where

a. Maximum Horizontal Crosstalk :

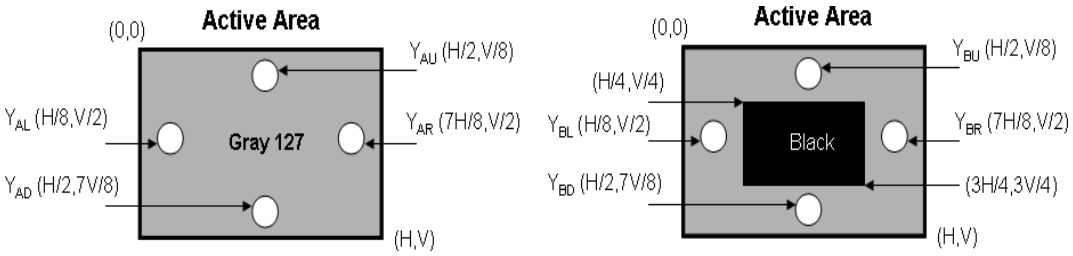
CTH = Max. (| YBL – YAL | / YAL × 100 %, | YBR – YAR | / YAR × 100 %);

Maximum Vertical Crosstalk:

CTV = Max. (| YBU – YAU | / YAU × 100 %, | YBD – YAD | / YAD × 100 %);

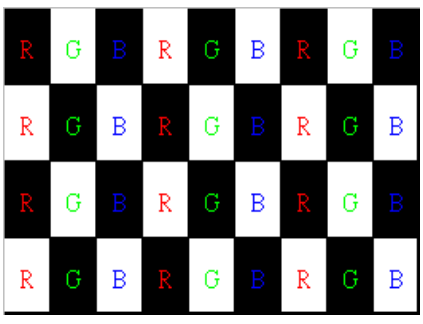
b. YAU, YAD, YAL, YAR = Luminance of measured location without Black pattern

YBU, YBD, YBL, YBR = Luminance of measured location with Black pattern



Note 1-7: Flicker measurement

a. Test pattern: It is listed as following.



Gray level = L0

Gray level = L127

R: Red, G: Green, B: Blue

b. Measured position: Center of screen (P5) & perpendicular to the screen (θ=Φ=0°)

1.3 Mechanical Characteristics

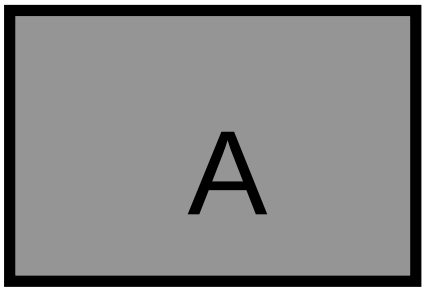
The contents provide general mechanical characteristics for the model HXXXXXXXX.X In addition the figures in the next page are detailed mechanical drawing of the LCD.

Item		Dimension	Unit	Note
Outline Dimension	Horizontal	495.6	mm	
	Vertical	292.2	mm	
Weight	1670		G	

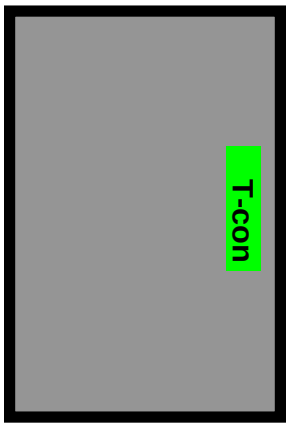
1.4 Placement Suggestions

1. Landscape Mode: The default placement is T-Con Side on the lower side and the image is shown upright via viewing from the front.
2. Portrait Mode: The default placement is that T-Con side has to be placed on the left side via viewing from the front.

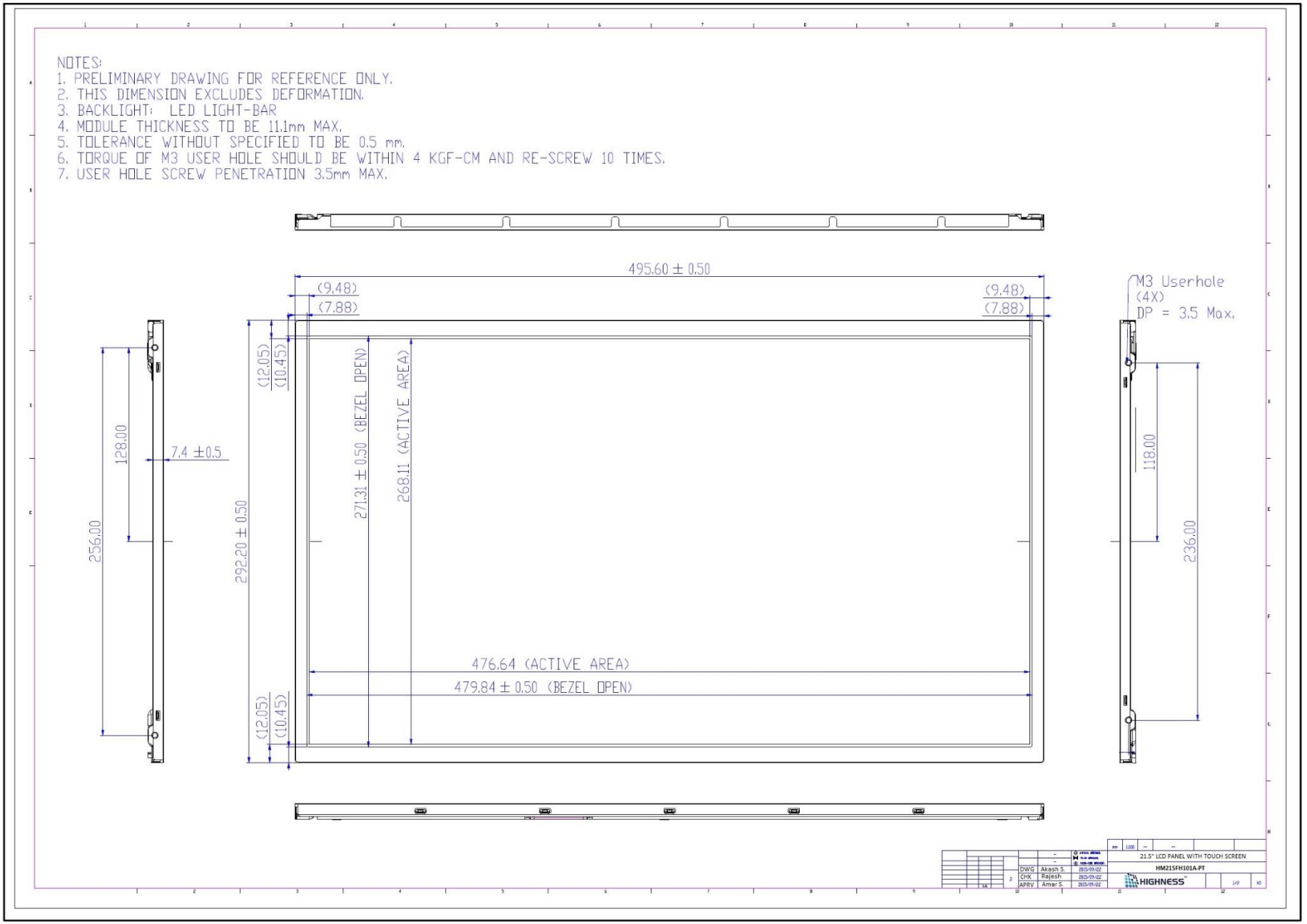
Landscape (Front view)



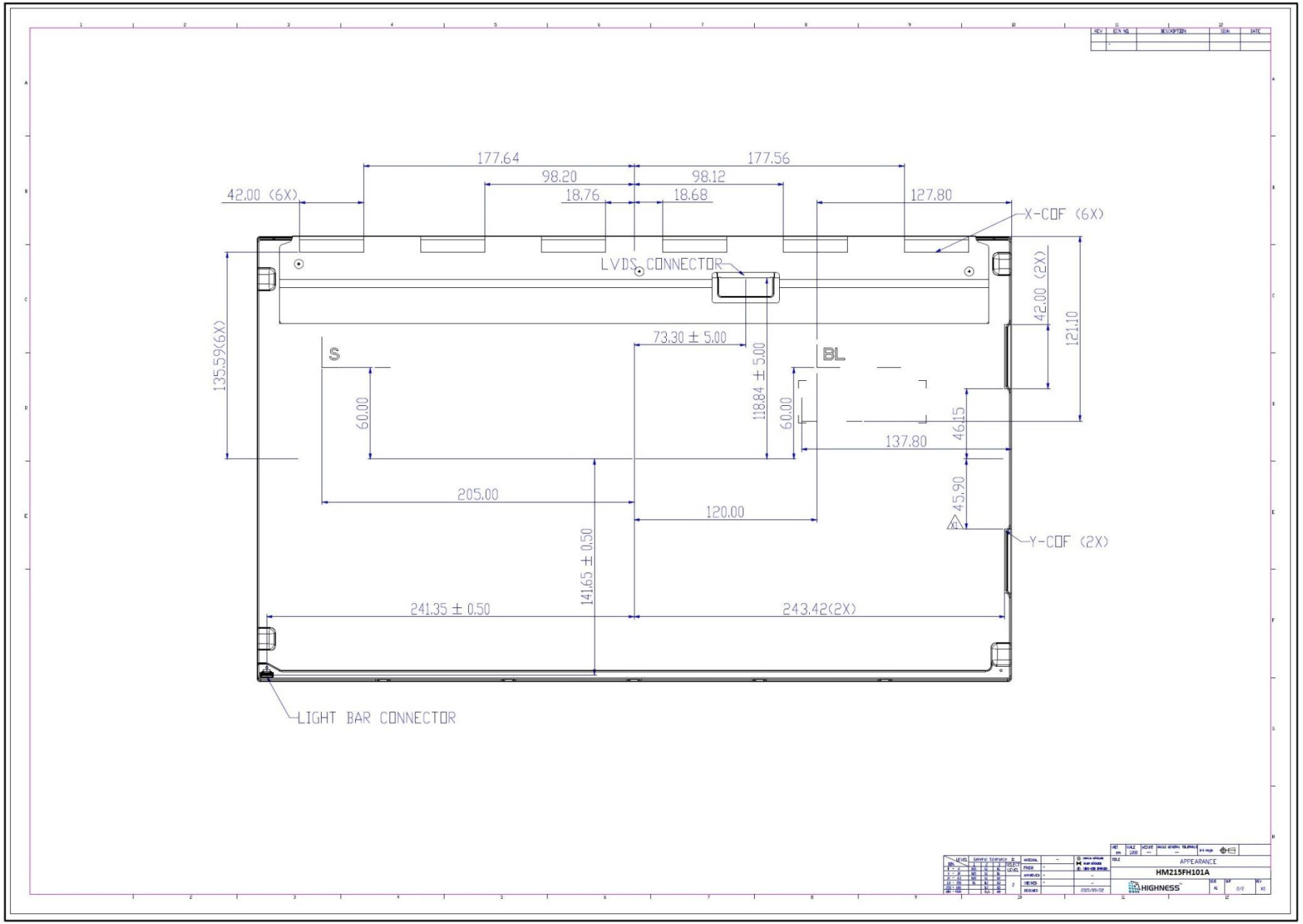
Portrait (Front view)



1.5 Front View



1.6 Back View


177.64
177.56
98.20
98.12
42.00 (6X)
18.76
18.68
127.80
X-COF (6X)
LVDS CONNECTOR
42.00 (2X)
121.10
135.59(6X)
73.30 ± 5.00
S
BL
118.84 ± 5.00
60.00
60.00
46.15
137.80
205.00
120.00
45.90
Y-COF (2X)
141.65 ± 0.50
241.35 ± 0.50
243.42(2X)
LIGHT BAR CONNECTOR
APPEARANCE
HM215FH101A
HIGHNESS

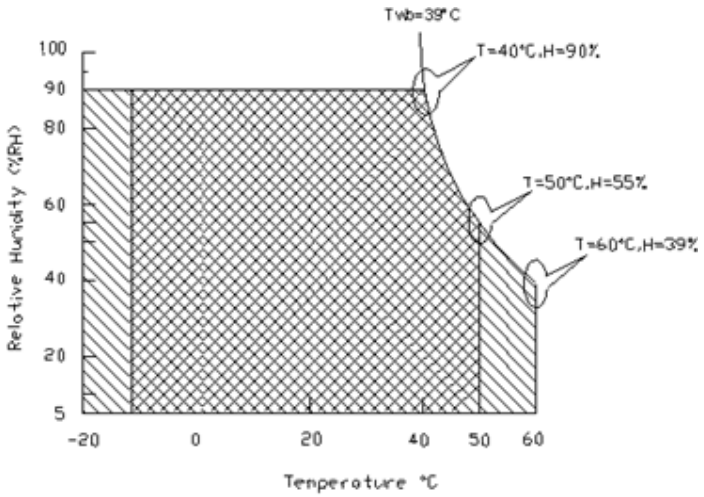
2. Absolute Maximum Ratings

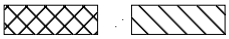
The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit Permanent damage may occur if exceeding the following maximum rating.

Symbol	Description	Min.	Max.	Unit	Remark
TOP	Operating Temperature	-10	+50	[oC]	Note 2-1
TGS	Glass surface temperature (operation)	0	+65	[oC]	Note 2-1 Function judged only
HOP	Operation Humidity	5	90	[%RH]	Note 2-1
TST	Storage Temperature	-20	+60	[oC]	
HST	Storage Humidity	5	90	[%RH]	

Note 2-1: Temperature and relative humidity range are shown as the below figure.

1. 90% RH Max (Ta □39□)
2. Max wet-bulb temperature at 39□ or less. (Ta □39□)
3. No condensation



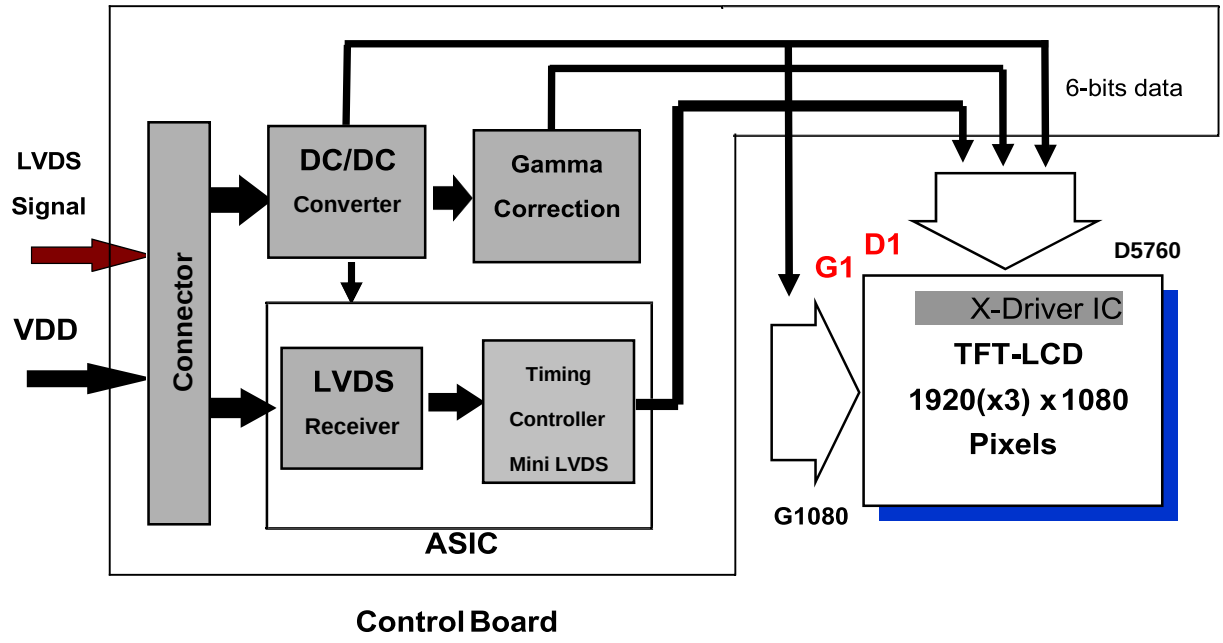
Operating Range  Storage Range 

3. Electrical Specification

The HM215FH01 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The other is to power Back Light Unit.

3.1 Block Diagram

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



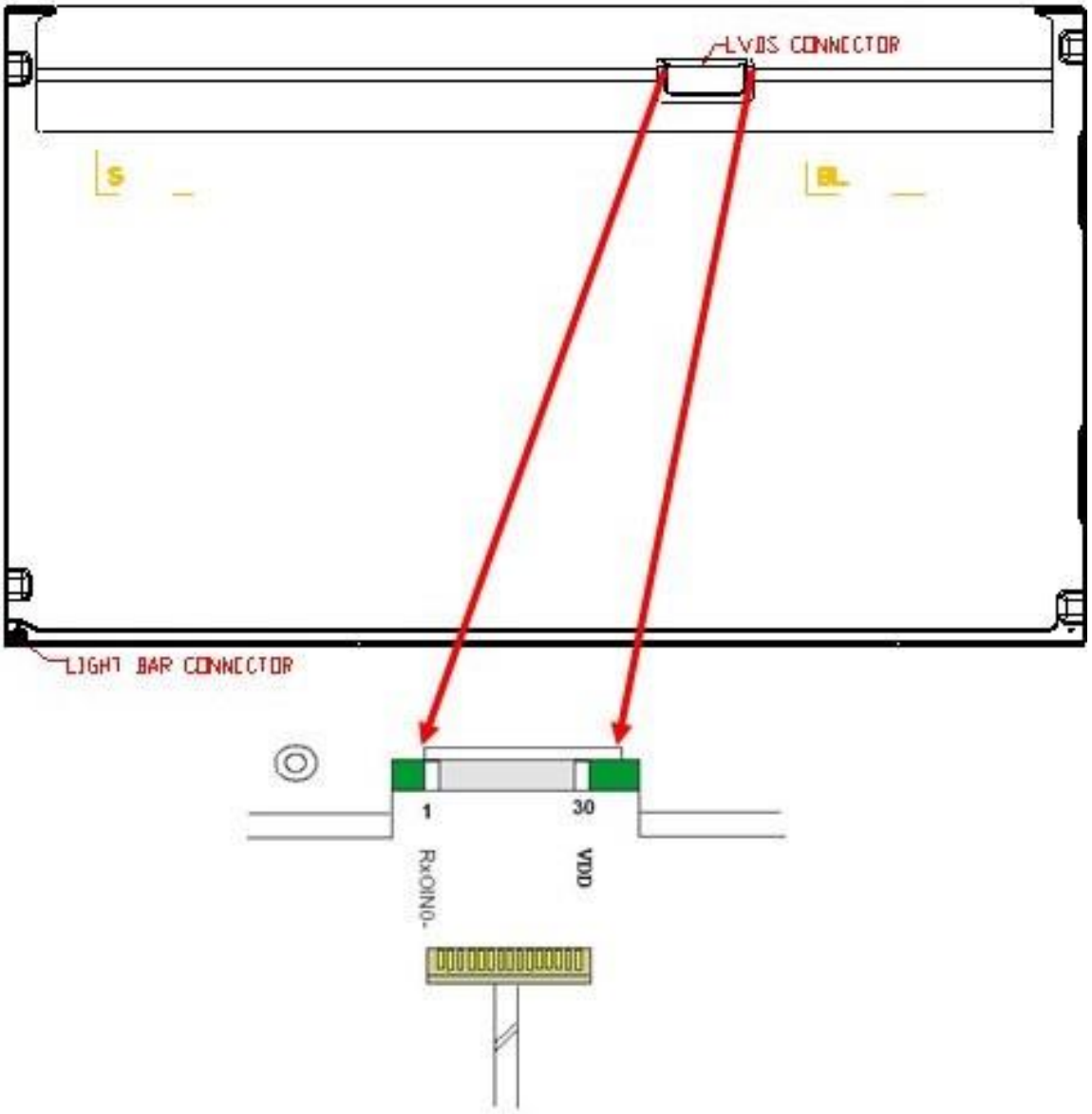
3.2 Interface Connection

3.2.1 Connector Type

TFT-LCD Connector	Manufacturer	P-TWO	STM
	Part Number	AL230F-A0G1D-P	MSCKT2407P30HB
Mating Connector	Manufacturer	JAE	
	Part Number	FI-X30HL (Locked Type)	

3.2.2 Connector Pin Assignment

PIN #	Symbol	Description	Remark
1	RxO0-	Negative LVDS differential data input (Odd data)	
2	RxO0+	Positive LVDS differential data input (Odd data)	
3	RxO1-	Negative LVDS differential data input (Odd data)	
4	RxO1+	Positive LVDS differential data input (Odd data)	
5	RxO2-	Negative LVDS differential data input (Odd data)	
6	RxO2+	Positive LVDS differential data input (Odd data)	
7	GND	Ground	
8	RxOCLK-	Negative LVDS differential clock input (Odd clock)	
9	RxOCLK+	Positive LVDS differential clock input (Odd clock)	
10	RxO3-	Negative LVDS differential data input (Odd data)	
11	RxO3+	Positive LVDS differential data input (Odd data)	
12	RxE0-	Negative LVDS differential data input (Even data)	
13	RxE0+	Positive LVDS differential data input (Even data)	
14	GND	Ground	
15	RxE1-	Negative LVDS differential data input (Even data)	
16	RxE1+	Positive LVDS differential data input (Even data)	
17	GND	Ground	
18	RxE2-	Negative LVDS differential data input (Even data)	
19	RxE2+	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	RxE3-	Negative LVDS differential data input (Even data)	
23	RxE3+	Positive LVDS differential data input (Even data)	
24	GND	Ground	
25	NC	No connection (for test only. Do not connect)	
26	NC	No connection (for test only. Do not connect)	
27	NC	No connection (for test only. Do not connect)	
28	VDD	Power Supply Input Voltage	
29	VDD	Power Supply Input Voltage	
30	VDD	Power Supply Input Voltage	


LVDS CONNECTOR
LIGHT BAR CONNECTOR
1
30
RxOIN0-
VDD

3.3 Electrical Characteristics

3.3.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

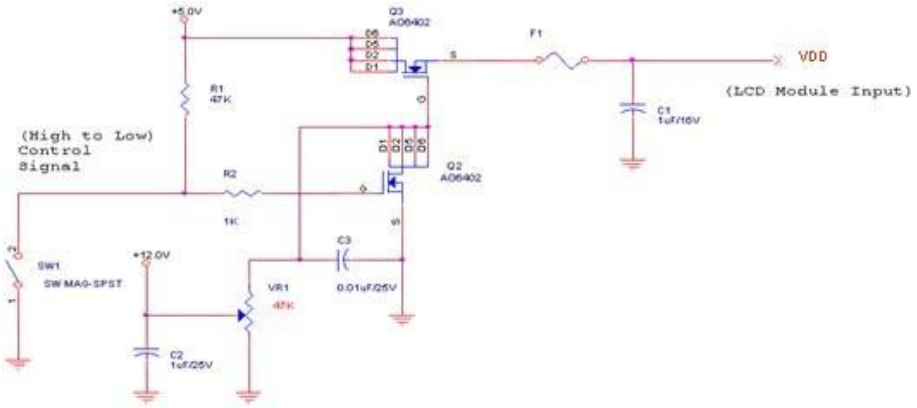
Symbol	Description	Min	Max	Unit	Remark
VDD	Power Supply Input Voltage	GND-0.3	6.0	[Volt]	Ta=25□

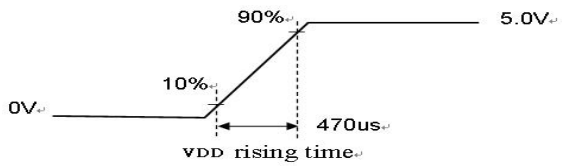
3.3.2 Recommended Operating Condition

Symbol	Description	Min	Typ	Max	Unit	Remark
VDD	Power supply Input voltage	4.5	5.0	5.5	[Volt]	
IDD	Power supply Input Current (RMS)	-	0.62	0.74	[A]	VDD= 5.0V, All white Pattern, Fv=60Hz
			0.7	0.84	[A]	VDD= 5.0V, All white Pattern, Fv=75Hz
PDD	VDD PowerVDD Power Consumption	-	3.1	3.7	[Watt]	VDD= 5.0V, All white Pattern, Fv=60Hz
			3.5	4.2	[Watt]	VDD= 5.0V, All white Pattern, Fv=75Hz
IRush	Inrush Current	-	-	3.0	[A]	Note 3-1
VDDrp	Allowable VDD Ripple Voltage	-	-	500	[mV]	VDD= 5.0V, All white Pattern, Fv=75Hz

Note 3-1: Inrush Current measurement:

Test circuit:

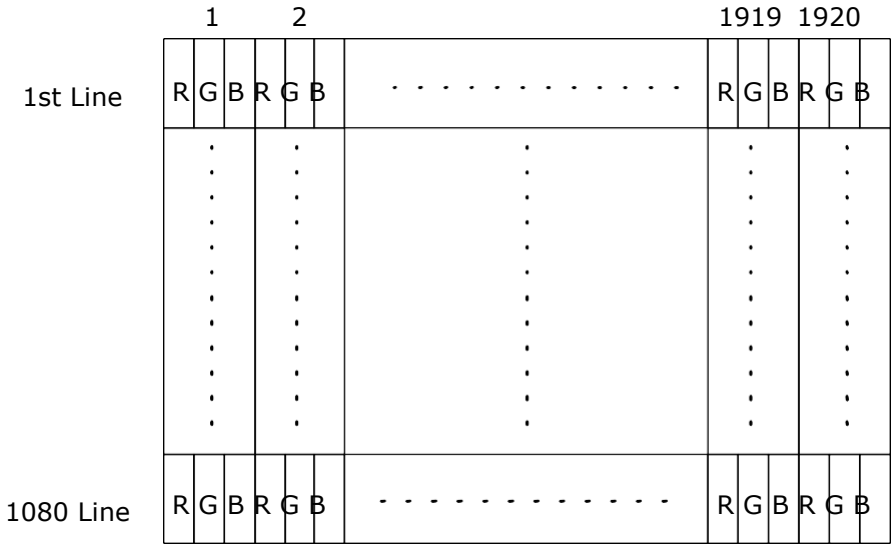




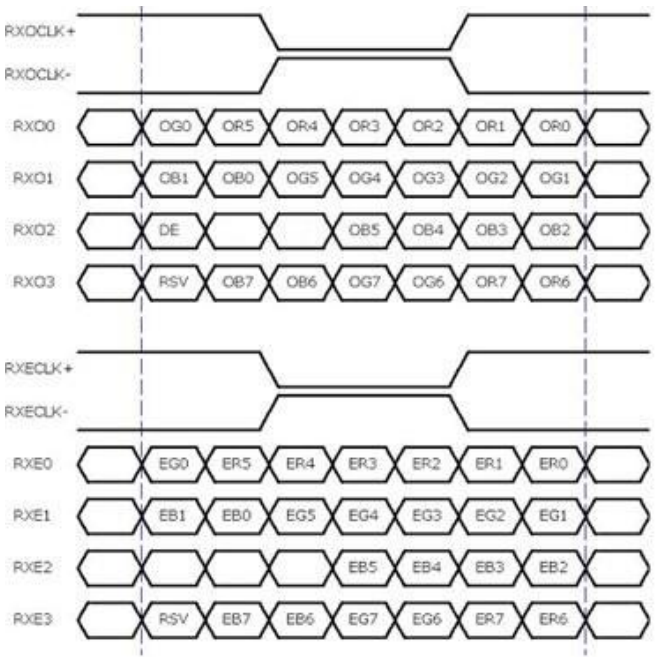
The duration of VDD rising time: 470us.

3.4 Signal Characteristics

3.4.1 LCD Pixel Format



3.4.2 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 3-2:

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).

3.5 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	

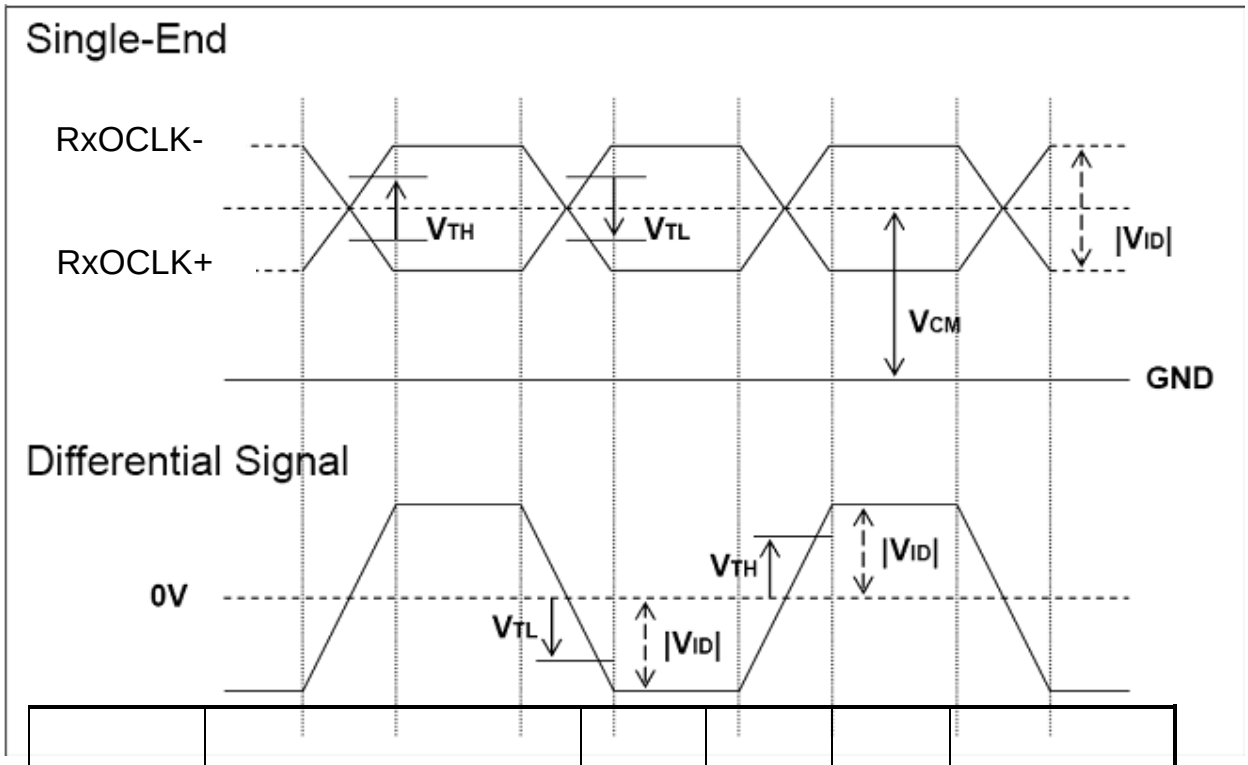
3.6 LVDS Specification

a. DC Characteristics:

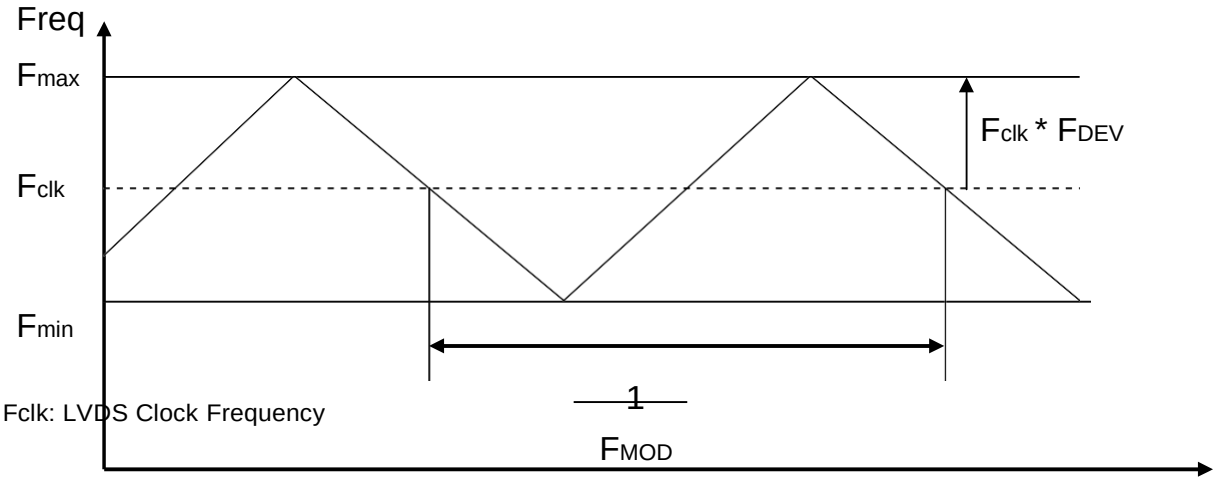
Symbol	Description	Min	Typ	Max	Units	Condition
VTH	LVDS Differential Input High Threshold	-	-	+100	[mV]	VCM = 1.2V
VTL	LVDS Differential Input Low Threshold	-100	-	-	[mV]	VCM = 1.2V
|VID|	LVDS Differential Input Voltage	100	-	600	[mV]	
VCM	LVDS Common Mode Voltage	+1.0	+1.2	+1.5	[V]	VTH-VTL = 200mV

LVDS Signal Waveform:

Use RxOCLK- & RxOCLK+ as example.



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

< Spread Spectrum>

3.7 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 3-3: 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.);

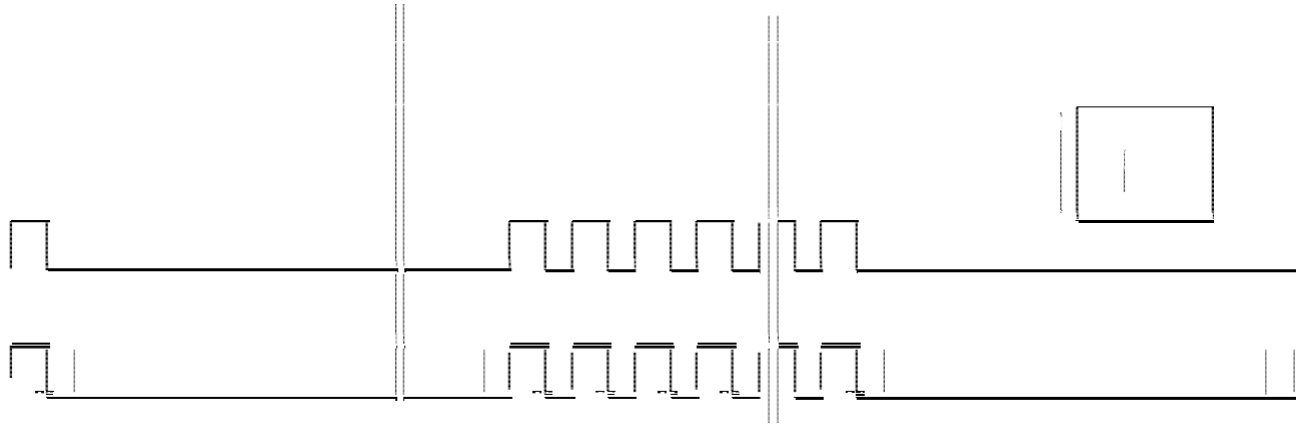
Note 3-4: The equation is listed as following. Please don't exceed the above recommended value.

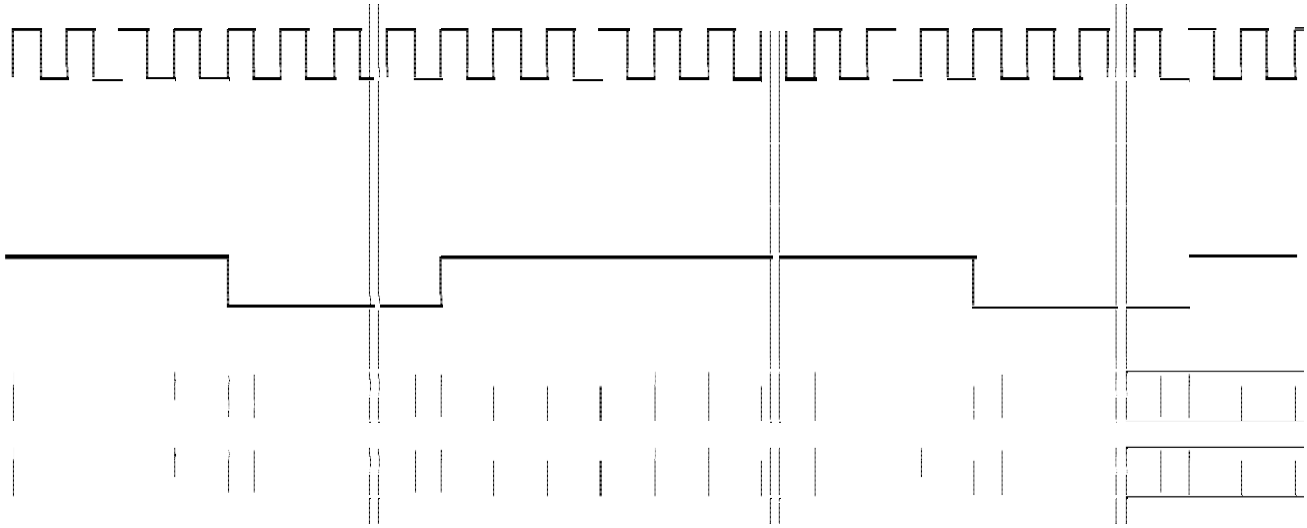
Fclk (Min.) = Fv (Min.) x Th (Min.) x Tv (Min.);

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

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

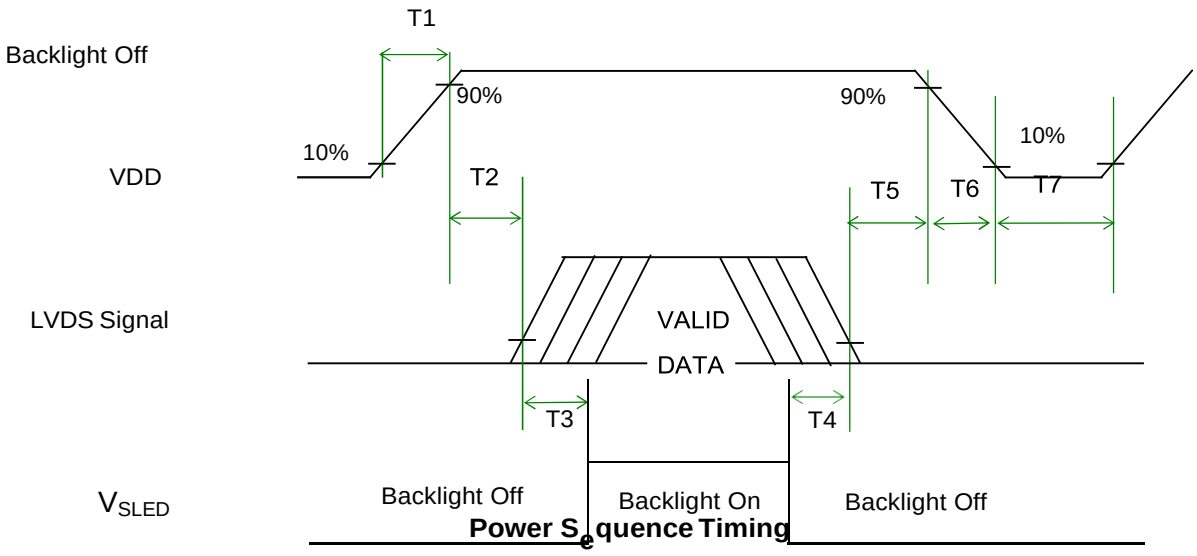
3.8 Input Timing Diagram





3.9 Power ON/OFF 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.



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]	Note 3-5 Note 3-6
T6	0	-	200	[ms]	Note 3-6 Note 3-7
T7	1000	-	-	[ms]	

Note 3-5 : Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

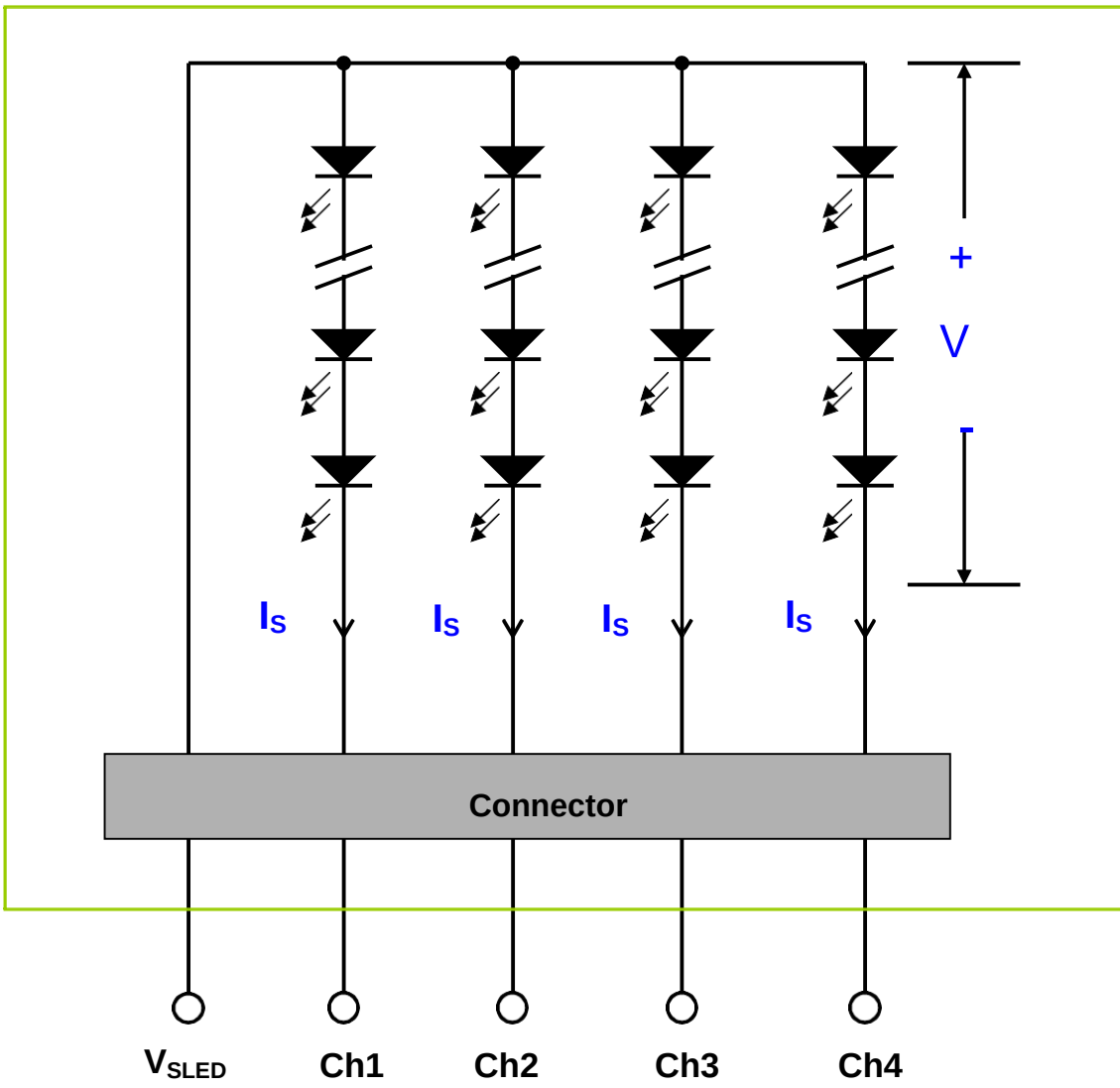
Note 3-6 : During T5 and T6 period , please keep the level of input LVDS signals with Hi-Z state.

Note 3-7 : Voltage of VDD must decay smoothly after power-off. (customer system decide this value)

4. Backlight Unit

4.1 Block Diagram

The following shows the block diagram of the 21.5 inch Backlight Unit. And it includes 60 pcs LED in the LED light bar. (4 strings and 15 pcs LED of one string).



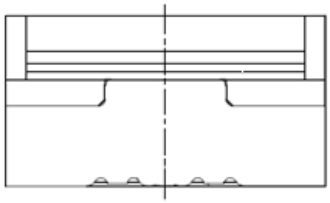
4.2 Interface Connection

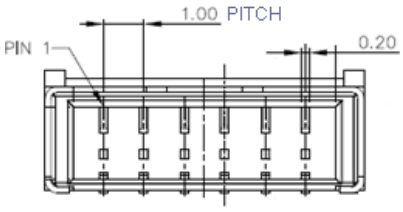
4.2.1 Connector Type

Backlight Connector	Manufacturer	ENTERY
	Part Number	3707K-S06N-21R
Mating Connector	Manufacturer	ENTERY
	Part Number	H112K-P06N-00B (Non-Locking type) H112K-P06N-03B (Locking type)

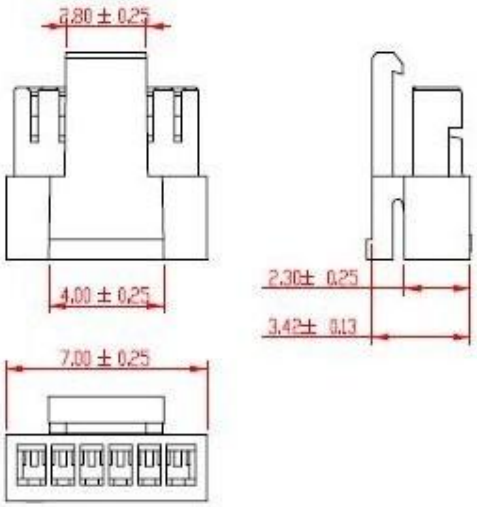
Backlight Connector dimension:

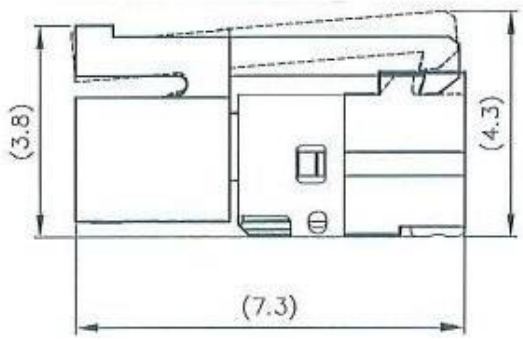
$H \times V \times D = 13.9 \times 3.00 \times 4.25,\ Pitch = 1.0(unit = mm)$





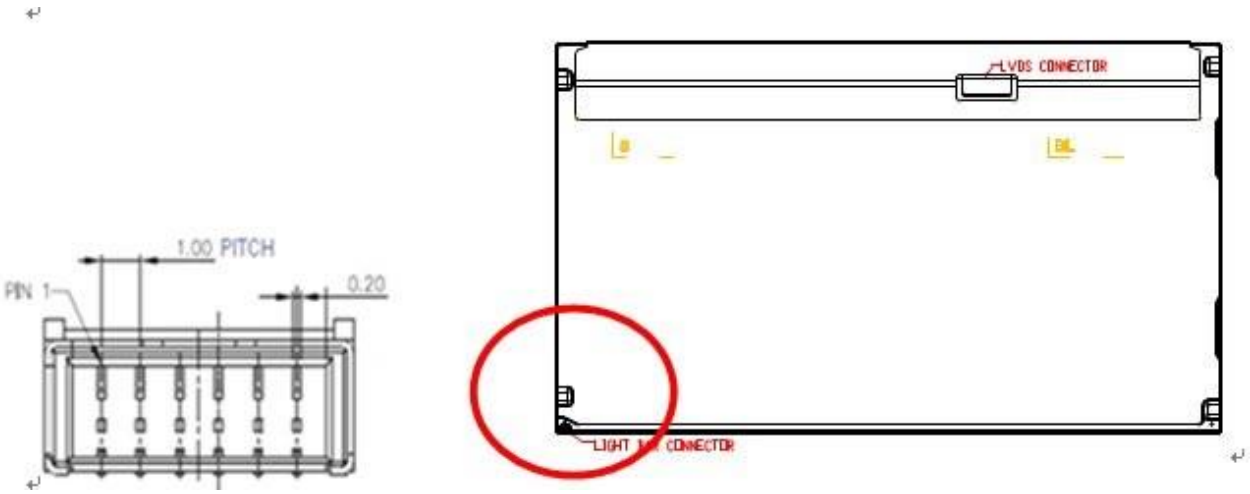
Mating Connector dimension:





4.3 Connector Pin Assignment

Pin#	Symbol	Description	Remark
1	Ch1	LED Current Feedback Terminal (Channel 1)	
2	Ch2	LED Current Feedback Terminal (Channel 2)	
3	V_{SLED}	LED Power Supply Voltage Input Terminal	
4	V_{SLED}	LED Power Supply Voltage Input Terminal	
5	Ch3	LED Current Feedback Terminal (Channel 3)	
6	Ch4	LED Current Feedback Terminal (Channel 4)	



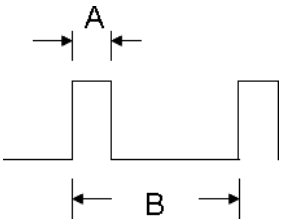
4.4 Electrical Characteristics

4.4.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

(Ta=25℃)

Symbol	Description	Min	Max	Unit	Remark
Is	LED String Current	0	90	[mA]	100% duty ratio
			150	[mA]	Duty ratio≦ 10% Pulse time=10 ms



Duty ratio= (A / B) X 100% ; (A: Pulse time, B: Period)

4.4.2 Recommended Operating Condition

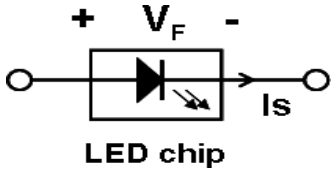
(Ta=25□)

Symbol	Description	Min.	Typ.	Max.	Unit	Remark
Is	LED String Current	-	65	72	[mA]	100% duty ratio of LED chip
Vs	LED String Voltage	-	46.5	51	[Volt]	Is=65mA @ 100% duty ratio; ***Note 4-1, Note 4-5***
ΔVs	Maximum Vs Voltage Deviation of light bar	-	-	4.5	[Volt]	Is=65mA @ 100% duty ratio; ***Note 4-2***
P_{BLU}	LED Light Bar Power Consumption	-	12.1	13.3	[Watt]	***Note 4-3***
LT_{LED}	LED Life Time	30,000	-	-	[Hour]	***Note 4-4***
OVP	Over Voltage Protection in system board	110% Vsmax	-	-	[Volt]	***Note 4-5***

Note 4-1: Vs (Typ.) = V_F (Typ.) X LED No. (one string);

a. V_F: LED chip forward voltage, V_F (Min.)= 2.8V, V_F(Typ.)=3.1V, V_F(Max.)=3.4V

b. The same euqation to calculate Vs(Min.) & Vs (Max.) for respective V_F(Min.) & V_F(Max.);



Note 4-2: ΔVs (Max.) = ΔV_F X LED No. (one string);

a. ΔV_F:LED chip forward voltage deviation; (0.3 V , each Bin of LED V_F)

Note 4-3: P_{BLU} (Typ.) = Vs (Typ.) X Is (Typ.) X 4 ; (4 is total String No. of LED Light bar)

P_{BLU} (Max.) = Vs (Max.) X Is (Typ.) X 4 ;

Note 4-4: Definition of life time:

a. Brightness of LED becomes to 50% of its original value

b. Test condition: Is = 65mA and 25℃ (Room Temperature)

Note 4-5: Recommendation for LED driver power design:

Due to there are electrical property deviation in LED & monitor set system component after long time operation.Strongly recommend the design value of LED driver board OVP (over voltage protection) should be 10% higher than max. value of LED string voltage (Vs) at least.

Note 4-6: Strongly recommend “Analog Dimming” method for backlight brightness control for Wavy Noise Free. Otherwise, recommend that Dimming Control Signal (PWM Signal) should be synchronized with Frame Frequency.

5. TOUCH SCREENSPECIFICATION

5.1 Overview

This is a Projected Capacitive Touch Panel module with multi touch technology function.

5.2 Specification:

Items	Specification
Screen Diagonal (inch)	21.5”
Structure	Glass / Glass
Touch Controller	USB TYPE
Out Line Dimension (mm)	To be advised
Active area	To be advised
Viewing area	To be advised
Total Thickness (mm)	2.70
Resolution Support	4096 x 4096
Hardness	3H
Durability	10 Million touch
Touch Response Time	15ms

5.3 Characteristics of Touch Screen:

5.3.1 Product Characteristics

Items	Specification
Operation Conditions	-20°C~+75°C at Min 5% to Max 95%RH
Storage Conditions	-40°C~+85°C at Min 5% to Max 95%RH
Electrostatic Discharge (non operation)	25ppi (Min)

5.3.2 Optical Property:

Items	Specification
Transmittance (T%)	>85%
Haze	3%

Note: Light source C-light (Measure point: Center of panel)

5.3.3 Electrical Characteristics:

Interface to Host/Master	Specification
Interface	USB 2.0
Supply Voltage	5V DC
Support Points	Multi-finger (10 Point Touch)

5.4 Touch Screen Controller PIN:

(To be advised)

5.5 Touch controller Diagram:

(To be advised)

6. Reliability Test Items

Reliability test items are listed as following table. (*Bare Panel only*)

Items	**Condition**	**Remark**
Temperature Humidity Bias (THB)	Ta= 50°C, 80%RH, 300hours	
High Temperature Operation (HTO)	Ta= 50°C, 50%RH, 300hours	
Low Temperature Operation (LTO)	Ta= 0°C, 300hours	
High Temperature Storage (HTS)	Ta= 60°C, 300hours	
Low Temperature Storage (LTS)	Ta= -20°C, 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)	Acceleration: 50 G Wave: Half-sine Active Time: 20 ms Direction: ±X, ±Y, ±Z (one time for each Axis)	
Thermal Shock Test (TST)	-20°C/30min, 60°C/30min, 100 cycles	***Note 5-1***
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: ± 15KV, 150pF(330Ω) 1sec, 8 points, 25 times/ point.	***Note 5-2***
	Air Discharge: ± 15KV, 150pF(330Ω) 1sec 8 points, 25 times/ point.	
Altitude Test	Operation:18,000 ft Non-Operation:40,000 ft	

Note 5-1: a. 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.

b. After finish temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

Note 5-2: EN61000-4-2, ESD class B: Certain performance degradation allowed

No data lost

Self-recoverable

No hardware failures.

7. International Standard

Safety

(1) UL 60950-1; Standard for Safety of Information Technology Equipment Including electrical Business Equipment.

(2) IEC 60950-1; Standard for Safety of International Electrotechnical Commission

(3) EN 60950-1; European Committee for Electrotechnical Standardization (CENELEC), EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

EMC

(1) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. “American National standards Institute(ANSI), 1992

(2) C.I.S.P.R “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” International Special committee on Radio Interference.

(3) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” European Committee for Electrotechnical Standardization. (CENELEC), 1998

8. Precautions

Please pay attention to the followings when you use this TFT LCD module.

Mounting Precautions

(1) You must mount a module using holes arranged in four corners or four sides.

(2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.

(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause circuit broken by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizer with glass, tweezers or 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.)

(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with 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.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage: V=±200mV(Over and under shoot voltage)

(2) Response time depends on the temperature. (In lower temperature, it becomes longer..)

(3) Brightness depends on the temperature. (In lower temperature, it may become lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.

(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

(5) When fixed patterns are displayed for a long time, remnant image is likelyto occur.

(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

Operating Condition for Public Information Display

The device listed in the product specification is designed and manufactured for PID (Public Information

Display) application. To optimize module's lifetime and function, below operating usages are required.

(1) Normal operating condition
   A. Operating temperature: -10~5 ℃
   B. Operating humidity: 10~90%
   C. Display pattern: dynamic pattern (Real display).
      Note) Long-term static display would cause image sticking.

(1) Operation usage to protect against image sticking due to long-term static display.
   A. Suitable operating time: 20 hours a day or less.
      (* The moving picture can be allowed for 24 hours a day)
   B. Liquid Crystal refresh time is required. Cycling display between 5 minutes' information (static) display and 10 seconds' moving image.
   C. Periodically change background and character (image) color.
   D. Avoid combination of background and character with large different luminance.

(2) Periodically adopt one of the following actions after long time display.
   A. Running the screen saver (motion picture or black pattern)
   B. Power off the system for a while

(3) LCD system is required to place in well-ventilated environment. Adapting active cooling system is highly recommended.

(4) Product reliability and functions are only guaranteed when the product is used under right operation usages. If product will be used in extreme conditions, such as high temperature/ humidity, display stationary patterns, or long operation time etc…, it is strongly recommended to contact for filed application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market and controlling systems.

Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5□ and 35□ at normal humidity.

(2) The polarizer surface should not come in contact with any other object. It is recommended that they

be stored in the container in which they were shipped.

(3) Storage condition is guaranteed under packing conditions.

(4) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition.

Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.

(3) You can remove the glue easily. When the glue remains on the bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.