

15" XGA**High brightness color TFT-LCD module****Model: VM15****Model control code: VM15BA V7****Date: Oct. 15th, 2018****Note: This specification is subject to change
without notice****Customer :** _____**Date :** _____**Approved****Prepared****Date:****Date:**

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RECORD OF REVISION

Version and Date	Page	Old description	New description	Remark																																																												
0.1 2018/1/2	All	First Edition for customer																																																														
0.2 2018/1/9	6 13	LED Line = 20.1 W $I_{LED} = 270 \text{ mA}$ $P_{LED} = 20.1 \text{ W}$	LED Line = 26.1 W $I_{LED} = 350 \text{ mA}$ $P_{LED} = 26.1 \text{ W}$																																																													
0.3 2018/06/12	6 13	LED Line = 26.1W <table border="1" data-bbox="571 629 847 696"> <thead> <tr> <th>Parameter</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td>LED voltage (VL)</td> <td></td> <td>37.2</td> <td></td> <td>[V]</td> <td>2</td> </tr> <tr> <td>LED current (IL)</td> <td></td> <td>350</td> <td></td> <td>[mA]</td> <td>2</td> </tr> <tr> <td>LED power (PL)</td> <td></td> <td>26.1</td> <td></td> <td>[W]</td> <td>3</td> </tr> <tr> <td>LED Life Time (TL,LED)</td> <td></td> <td>80,000</td> <td></td> <td>[Hour]</td> <td>1</td> </tr> </tbody> </table> <small>Note 1: The "LED life time" is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and typical LED Current at 350 mA. Note 2: The LED driving condition is defined for each LED module. Note 3: The variance of LED Light Bar power consumption is ±10%. Calculator value for reference ($I_L = VL \cdot I = 2 \cdot P_{LED}$)</small>	Parameter	Min.	Typ.	Max.	Unit	Note	LED voltage (VL)		37.2		[V]	2	LED current (IL)		350		[mA]	2	LED power (PL)		26.1		[W]	3	LED Life Time (TL,LED)		80,000		[Hour]	1	LED Line : 20.94W <table border="1" data-bbox="927 651 1203 719"> <thead> <tr> <th>Parameter</th> <th>Min.</th> <th>Typ.</th> <th>Max.</th> <th>Unit</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td>LED voltage (VL)</td> <td></td> <td>29.7</td> <td></td> <td>[V]</td> <td>2</td> </tr> <tr> <td>LED current (IL)</td> <td></td> <td>350</td> <td></td> <td>[mA]</td> <td>2</td> </tr> <tr> <td>LED power (PL)</td> <td></td> <td>20.94</td> <td></td> <td>[W]</td> <td>3</td> </tr> <tr> <td>LED Life Time (TL,LED)</td> <td></td> <td>80,000</td> <td></td> <td>[Hour]</td> <td>1</td> </tr> </tbody> </table> <small>Note 1: The "LED life time" is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and typical LED Current at 350 mA. Note 2: The LED driving condition is defined for each LED module. Note 3: The variance of LED Light Bar power consumption is ±10%. Calculator value for reference ($I_L = VL \cdot I = 2 \cdot P_{LED}$)</small>	Parameter	Min.	Typ.	Max.	Unit	Note	LED voltage (VL)		29.7		[V]	2	LED current (IL)		350		[mA]	2	LED power (PL)		20.94		[W]	3	LED Life Time (TL,LED)		80,000		[Hour]	1	
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0.4 2018 /10/15	13		Backlight life: 100,000 Hrs																																																													

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) In case if a Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of TFTLCD panel.
- 10) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
- 11) 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

VM15BA V7 is a Color Active Matrix Liquid Crystal Display composed of a TFT-LCD display, a driver circuit, and a backlight system. The screen format is intended to support XGA(1024(H) x 768(V)) screen and 16.2M (RGB 8-bits) or 262k colors (RGB 6-bits). All input signals are LVDS interface compatible. The design rules of this module can correspond to PSWG standard.

2.2 Features

- Sunlight readable display, 1500nits.
- LED backlight
- Wide view angle
- Wide operation temperature
- 100K hrs backlight operation life
- RoHS Compliance

2.3 Application

Industrial Application.

2.4 Display Specifications

Items	Unit	Specification
Screen Diagonal	inch	15
Active Area	mm	304.128(H) x 228.096(V)
Pixels H x V	pixels	1024x3(RGB) x 768
Pixels Pitch	um	297 (per one triad) x 297
Pixel Arrangement		RGB Vertical stripe
Display mode		Normally black
White luminance (center)	Cd/m ²	1500 (Typ.)
Contrast ratio		2500:1 (Typ.)
Optical Response Time	msec	21 ms (Typ. on/off)
Normal Input Voltage VDD	Volt	3.3
Power Consumption (VDD Line + LED Line)	Watt	TBD (VDD=TBD; LED= 20.94W)
Weight	Grams	1010 typ.
Physical size	mm	326.5(H)x 253.5(V) x 9.6(D) (typ.)
Electrical Interface		1 Channel LVDS
Support Colors		16.2 M (RGB 8-bits) / 262K (RGB 6-bits)
Surface Treatment		Anti-Glare, 3H
Temperature range		
Operating	°C	-30 ~ 80 (TFT surface temperature)
Storage (Shipping)	°C	-40 ~ 80
RoHS Compliance		RoHS Compliance

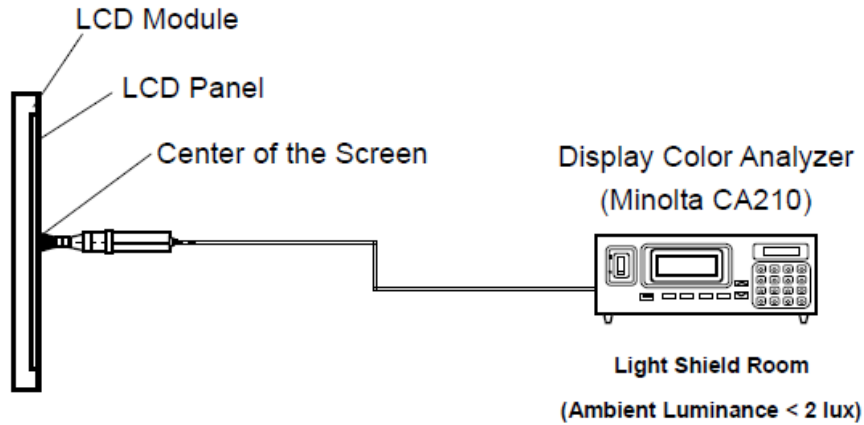
2.5 Optical Characteristics

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

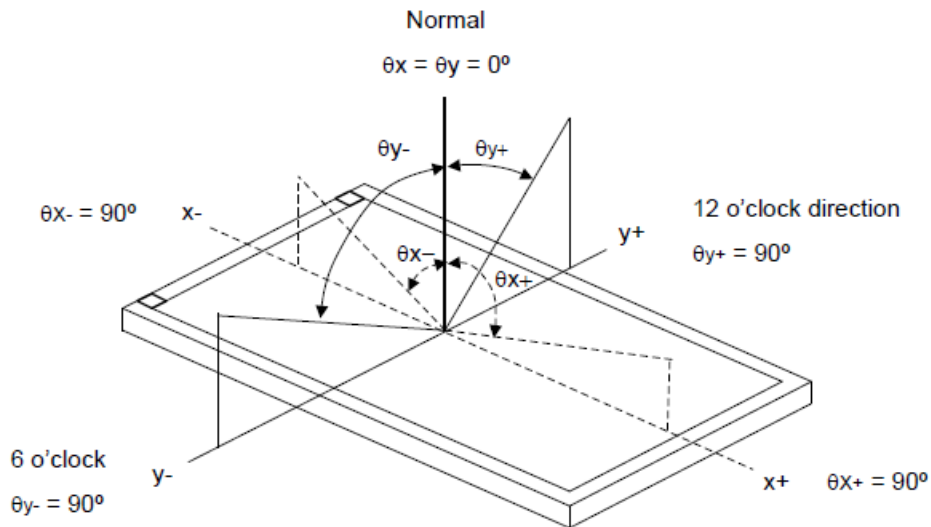
Items	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing angle	Deg.	Horizontal (Right) CR=10 (Left)	160	176		2
		Vertical (Up) CR=10 (Down)	160	176		
Contrast Ratio		Normal Direction	1500	2500		3
Response Time	msec	Raising time (T _{rR})		14		4
		Falling time (T _{rF})		7		
		Raising + Falling		21		
Color / Chromaticity Coordinates (CIE)		Red x	-0.05	0.64	+0.05	5
		Red y		0.34		
		Green x		0.32		
		Green y		0.60		
		Blue x		0.15		
		Blue y		0.6		
Color coordinates (CIE) White		White x		0.31		
		White y		0.33		
Center Luminance	Cd/m ²		1200	1500		6
Luminance Uniformity	%			70		7
Crosstalk (in 60 Hz)	%				1.2	
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.



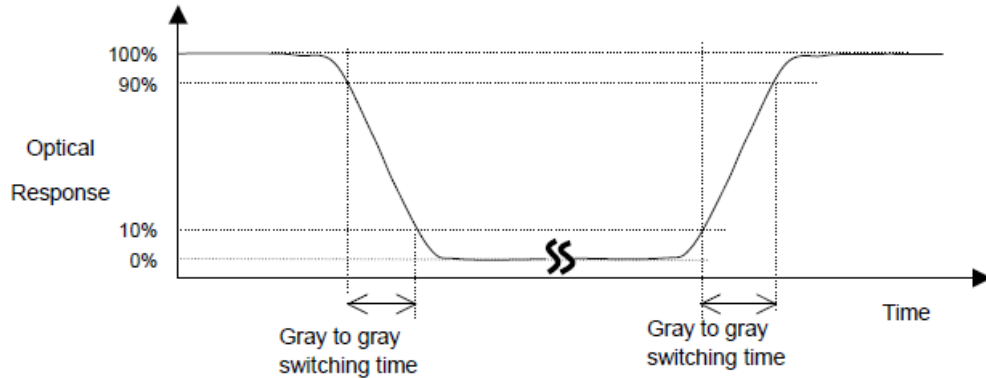
Note 2: Definition of viewing angle



Note 3: Contrast ratio is measured by Minolta CA210

Note 4: Definition of Response time

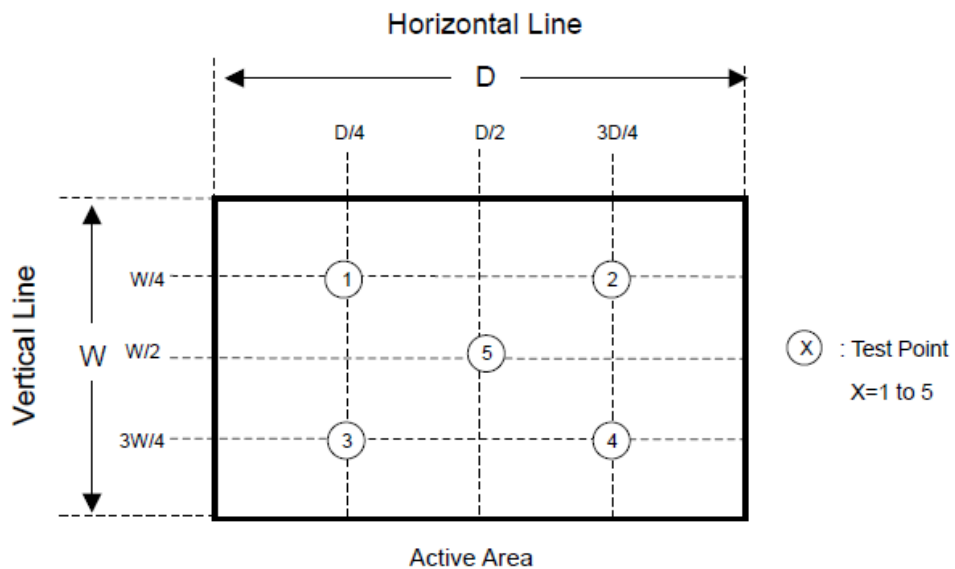
The output signals of photo detector are measured when the input signals are changed from “Full Black” to “Full White” (rising time), and from “Full White” to “Full Black” (falling time), respectively. The response time is interval between the 10% and 90% of amplitudes. Please refer to the figure as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



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

Note 6: Center luminance is measured by Minolta CA210

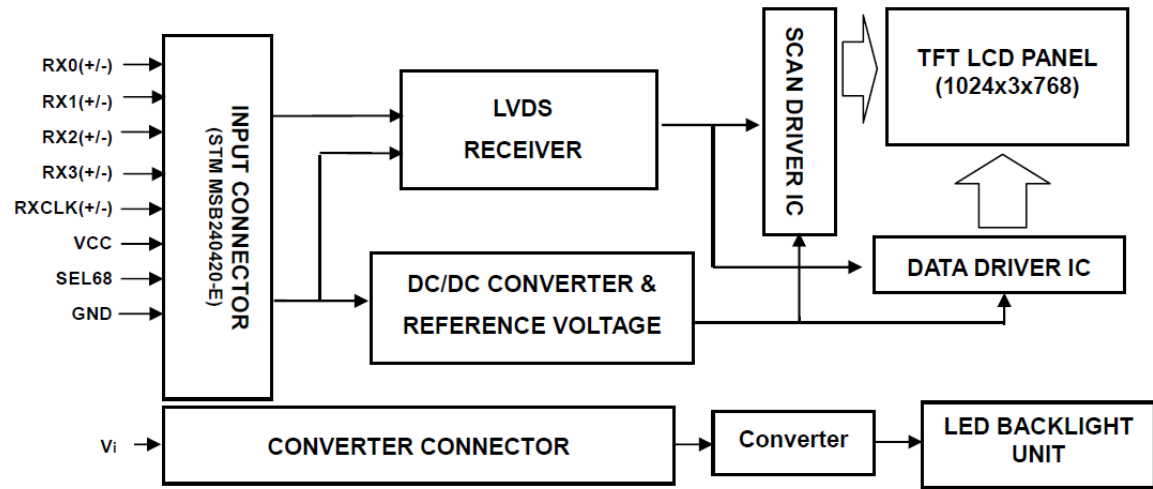
Note 7: Luminance uniformity of these 5 points is defined as below and measured by Minolta CA210



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

3. Functional Block Diagram

The following diagram shows the functional block of the 15 inches 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/ LCD drive voltage	V _{in}	-0.3	4.0	Volt	Note 1, 2

4.2 Backlight unit

Items	Symbol	Min	Max	Unit	Conditions
LED Current	I _{LED}		720	mA	Note 1, 2

4.3 Absolute Ratings of Environment

Items	Symbol	Values			Unit	Conditions
		Min.	Typ.	Max.		
Operation temperature	T _{OP}	-30	-	80	°C	Note 3
Operation Humidity	H _{OP}			90	%	
Storage temperature	T _{ST}	-40		80	°C	
Storage Humidity	H _{ST}			90	%	

Note 1: With in T_a= 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).

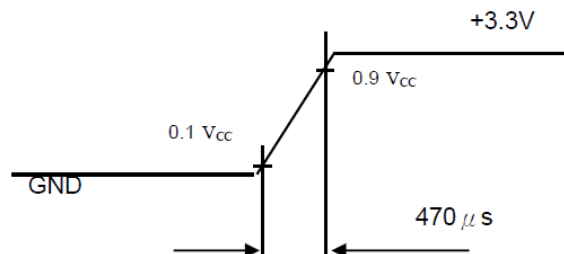
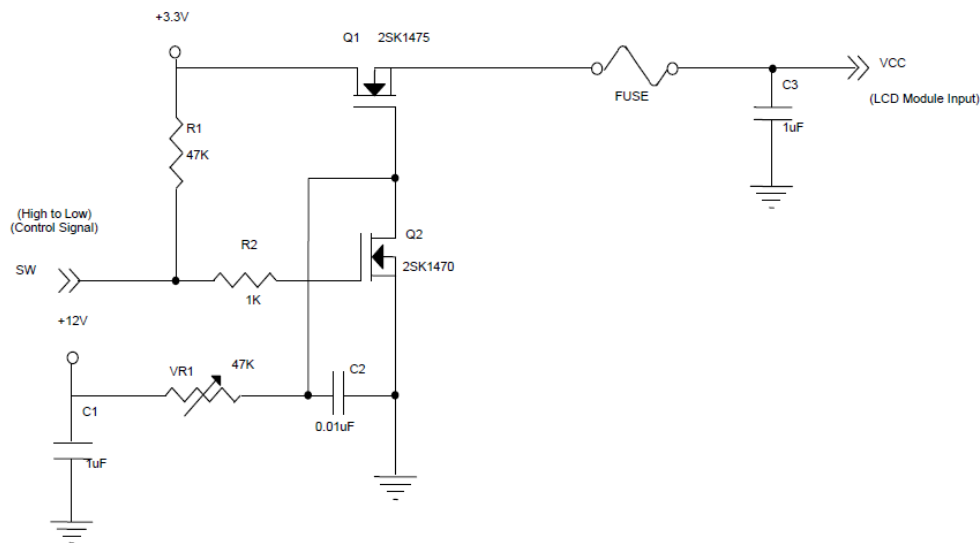
5. Electrical characteristics

5.1 TFT LCD Module

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	V_{CC}	3.0	3.3	3.6	V	-	
Ripple Voltage	V_{RP}	-	-	100	mVp-p		
Rush Current	I_{RUSH}	-	-	(TBD)	A	(2)	
Power Supply Current	White	I_{CC}	-	(TBD)	(TBD)	mA	(3)a
	Black		-	(TBD)	(TBD)	mA	(3)b
LVDS differential input voltage	V_{id}	200	-	600	mV		
LVDS common input voltage	V_{ic}	1.0	1.2	1.4	V		
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V_{IH}	-	-	100	mV	-
	"L" Level	V_{IL}	-100	-	-	mV	-
Terminating Resistor	R_T	-	100	-	Ohm	-	

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



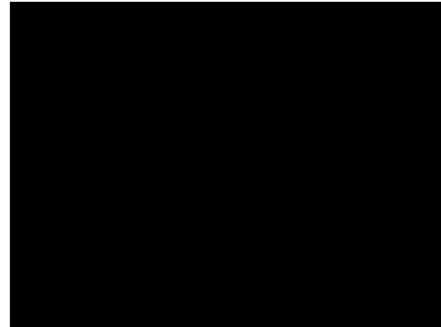
Note (3) The specified power supply current is under the conditions at VDD =3.3V, Ta = 25 ± 2 °C, DC. Current and fv = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

5.2 Backlight Unit

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

Parameter	Min	Typ	Max	Unit	Note
LED voltage (VL)		29.7		[V]	2
LED current (IL)		350		[mA]	2,
LED power (PL)		20.94		W	3
LED Life Time(LTLED)		100,000		[Hour]	1

Note 1: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and typical LED Current at 350 mA .

Note 2: The LED driving condition is defined for each LED module.

Note 3: The variance of LED Light Bar power consumption is ±10%. Calculator value for reference (IL × VL × 2 = PLED)

Note 4: LED Light Bar Connector is used for the integral backlight system. The recommended model is BHSR-02VS-1 manufactured by JST

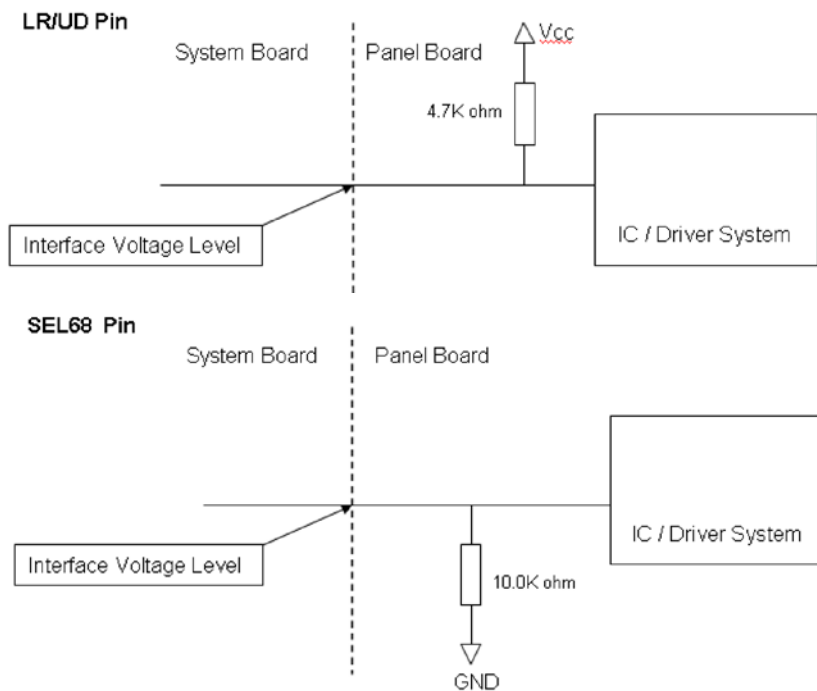
6.2 Signal Description

Pin No.	Symbol	Function	Polarity	Note
1	VCC	Power Supply +3.3V(typical)		
2	VCC	Power Supply +3.3V(typical)		
3	GND	Ground		
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizontal/ Vertical Reverse Scan.		
5	RX0-	LVDS Differential Data Input	Negative	
6	RX0+	LVDS Differential Data Input	Positive	
7	GND	Ground		
8	RX1-	LVDS Differential Data Input	Negative	
9	RX1+	LVDS Differential Data Input	Positive	
10	GND	Ground		
11	RX2-	LVDS Differential Data Input	Negative	
12	RX2+	LVDS Differential Data Input	Positive	
13	GND	Ground		
14	RXCLK-	LVDS Differential Data Input	Negative	
15	RXCLK+	LVDS Differential Data Input	Positive	
16	GND	Ground		
17	RX3-	LVDS Differential Data Input	Negative	
18	RX3+	LVDS Differential Data Input	Positive	
19	GND	Ground		
20	SEL68	LVDS 6/8 bit select function control, High → 6bit Input Mode Low or NC → 8bit Input Mode		Note (3)

Note (1) Connector Part No.: Entry 3804K-F20N-10L or equivalent.

Note (2) User's connector Part No.: Entry H204K-D20N-02B or equivalent.

Note (3) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".



6.2.1 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	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	
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
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	Red(252)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(252)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(252)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0		
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
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	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0		
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0		
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0		
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
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	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0		
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1		
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1		

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6.3 Interface Timing

6.3.1 Timing Characteristics

INPUT SIGNAL TIMING SPECIFICATIONS

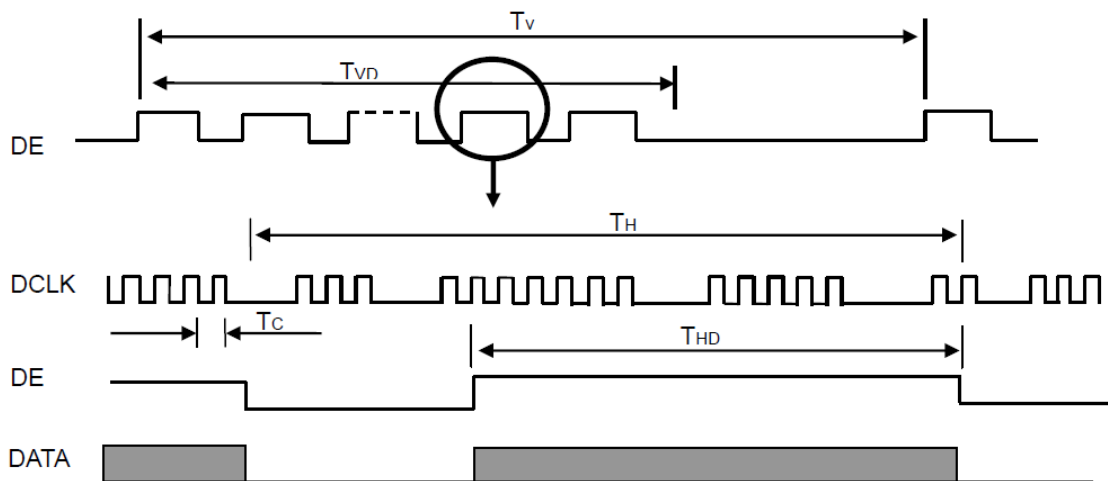
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F _c	53.35	65	80	MHz	-
	Period	T _c	12.5	15.38	18.75	ns	
	Input cycle to cycle jitter	T _{rcj}	---	---	(100)	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*T _c	-	0.02*T _c	ps	(b)
	Spread spectrum modulation range	F _{clk_in_mod}	-	-	1.02*F _c	MHz	(c)
	Spread spectrum modulation frequency	F _{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	--	60	--	Hz	T _v =T _{v_d} +T _{v_b}
	Total	T _v	780	806	1200	Th	-
	Active Display	T _{v_d}	768	768	768	Th	-
	Blank	T _{v_b}	T _v -T _{v_d}	38	T _v -T _{v_d}	Th	-
Horizontal Display Term	Total	T _h	1140	1344	1600	T _c	T _h =T _{h_d} +T _{h_b}
	Active Display	T _{h_d}	1024	1024	1024	T _c	-
	Blank	T _{h_b}	T _h -T _{h_d}	320	T _h -T _{h_d}	T _c	-

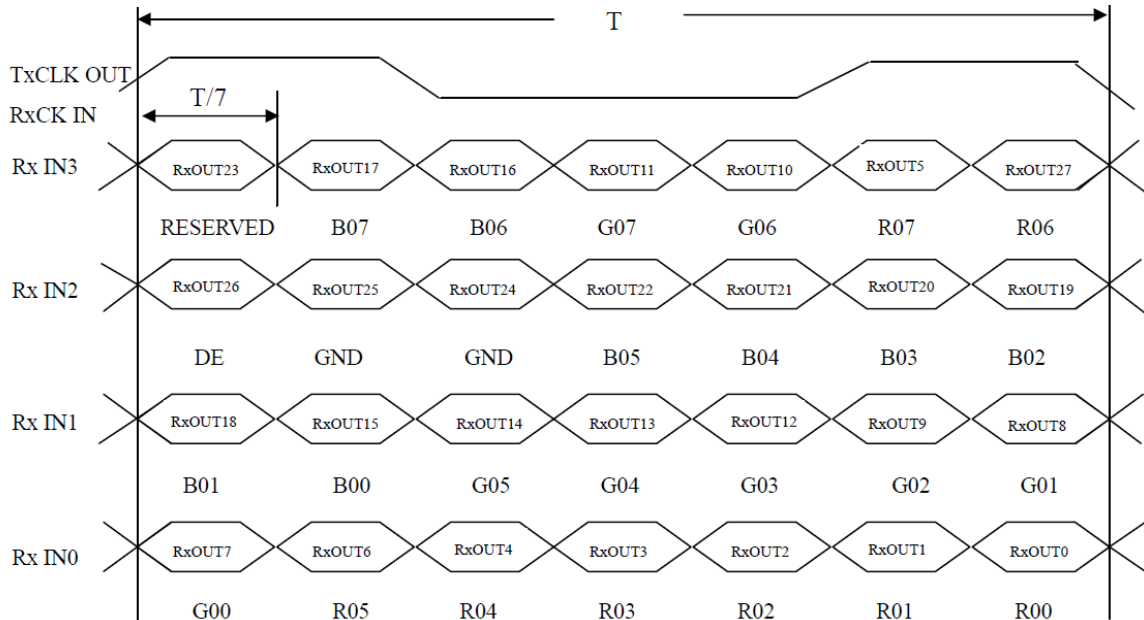
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

6.3.2 Input Timing Diagram

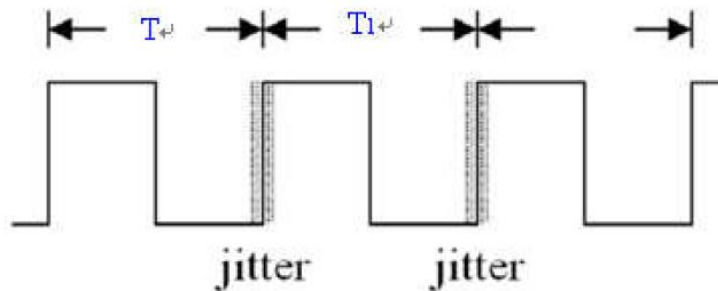
INPUT SIGNAL TIMING DIAGRAM



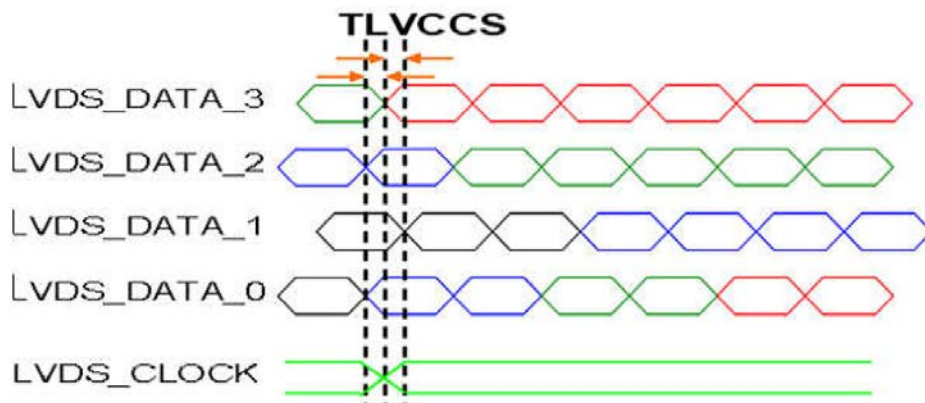
TIMING DIAGRAM of LVDS



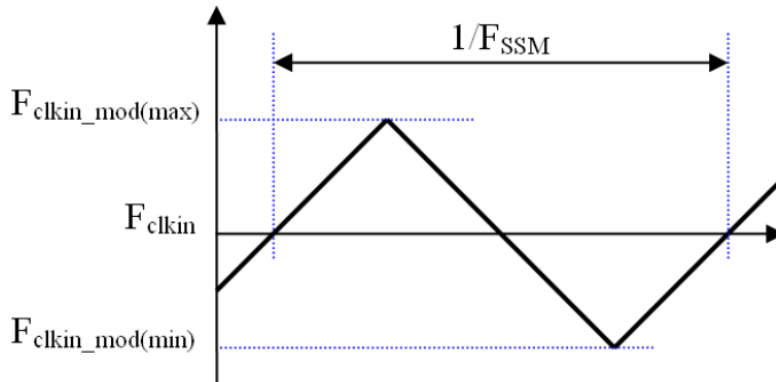
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T_1 - T_1|$



Note (b) Input Clock to data skew is defined as below figures.



Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.4 SCANNING DIRECTION

The following figures show the image see from the front view. The arrow indicates the direction of scan.



Fig. 1 Normal scan (pin 4, LR/UD = High or NC)

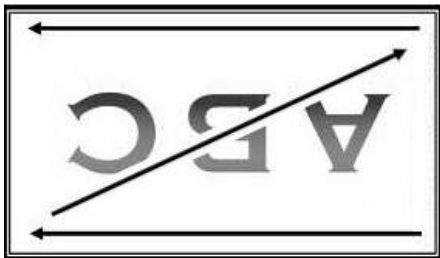
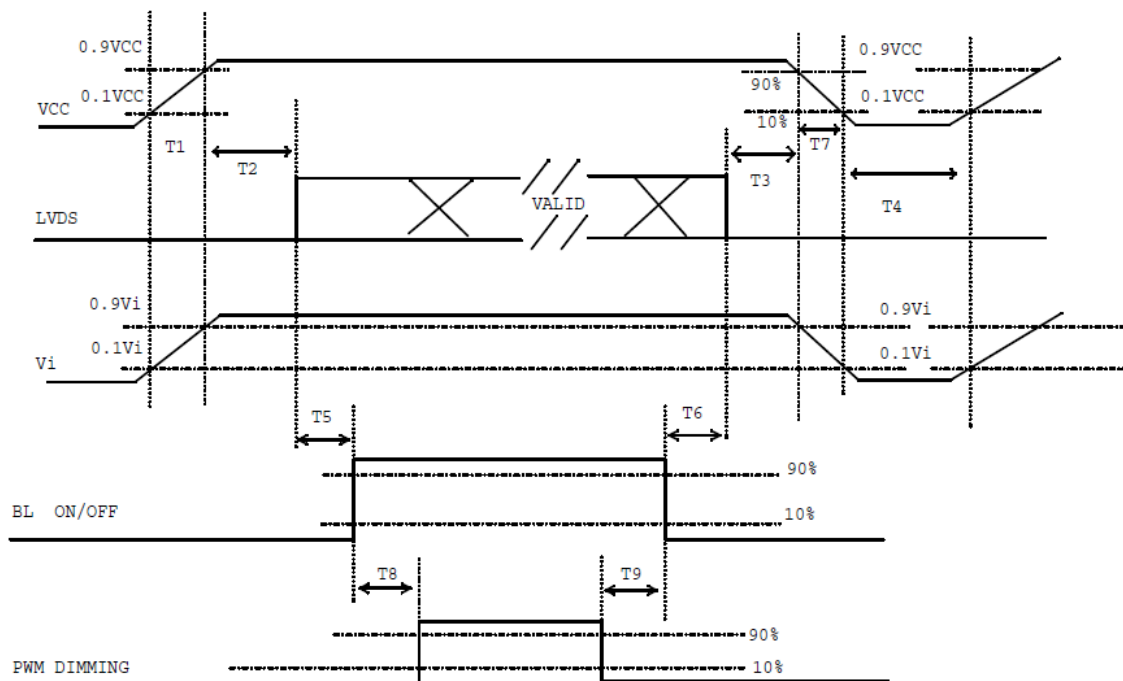


Fig. 2 Reverse scan (pin 4, LR/UD = Low)

6.4 Power ON/OFF Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



Power ON/OFF sequence timing

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	(0.5)	-	(10)	ms
T2	(0)	-	(50)	ms
T3	(0)	-	(50)	ms
T4	(500)	-	-	ms
T5	(200)	-	-	ms
T6	(200)	-	-	ms
T7	(5)	-	(300)	ms
T8	(10)	-	-	ms
T9	(10)	-	-	ms

7. Reliability Test

Environment test conditions are listed as following table.

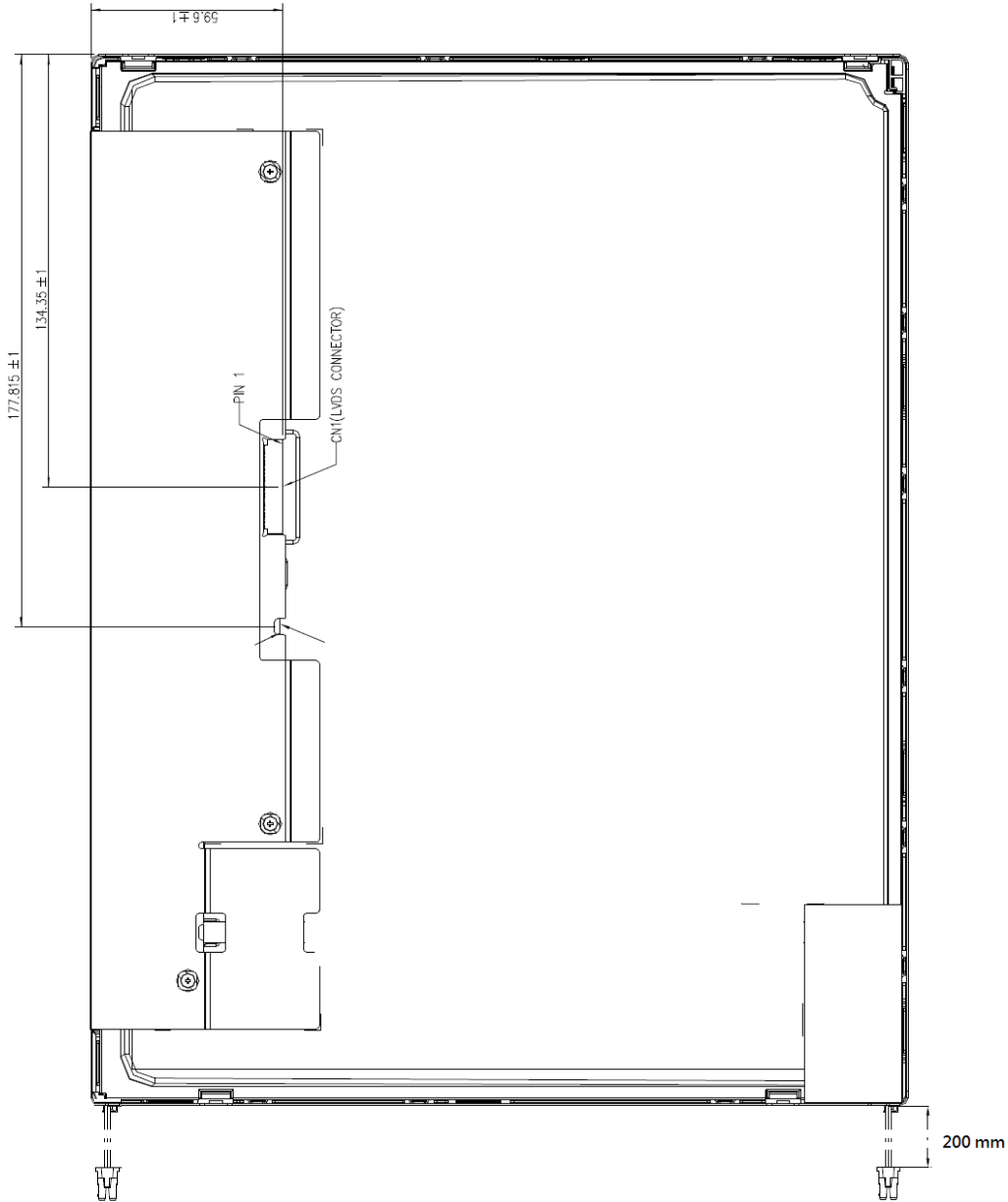
Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50°C, 80%RH, 48hours	
High Temperature Operation (HTO)	Ts= 80°C, 48hours	3
Low Temperature Operation (LTO)	Ta= -30°C, 48hours	
High Temperature Storage (HTS)	Ta= 80°C, 48hours	
Low Temperature Storage (LTS)	Ta= -40°C, 48hours	
Thermal Shock Test (TST)	-30°C/30min, 80°C/30min, 100 cycles	1
On/Off Test	On/10sec, Off/10sec, 30,000 cycles	
ESD (ElectroStatic Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω) 1sec, 9 points, 25 times/ point.	2
	Air Discharge: ± 15KV, 150pF(330Ω) 1sec 9 points, 25 times/ point.	2

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 -30°C to 80°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: The test items are tested by open frame type chassis.

8. Shipping Label & Package
(TBD)



- NOTES:
- 1. UNSPECIFIED TOLERANCE: $\pm 0.5\text{mm}$.
 - 2. DISPLAY AREA POSITION TOLERANCE: |A-B| $\leq 1.0\text{mm}$ & |C-D| $\leq 1.0\text{mm}$ (SEE FIG.1).
 - 3. ROTATIONAL TORQUE MUST BE MINIMUM 4 kgf-cm RE-SCREWED 10 TIMES.
 - 4. CONNECTOR TYPE:
 - CN1: CvLux CID520D1HR0-NH
 - CN2: CvLux C14205M2HRP-NH
 - 5. (*) MARKS THE REFERENCE DIMENSION.