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		Page: 21 pages (Include cover page, drawing)
Preliminary		

Specification for
TFT LCD Module

Model No. QD15XL16 REV:01

☐ Customer's Approval

Date

By

Approved By

The device listed in these technical literature sheets was designed and manufactured for use in OA equipment.

In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.

QDI assumes no responsibility for any damage resulting from the use of the device, which does not comply with the instructions, and the precautions specified in these technical literature sheets.

Contact and consult with a QDI sales representative for any questions about this device.

Revision History			
REV.	Date	ECN NO.	Change Content
1	May 13,'05	N/A	Preliminary specification Initiate
2	July,13,'05	N/A	Add established starting voltage (P.11)

Content List

1. Application

This specification applies to a color TFT-LCD module, QD15XL16

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel; driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a 1024×3×768 dots panel with 16.2 million colors by using the LVDS (Low Voltage Differential Signaling) interface, 6-bit+FRC driving method and supplying +5V DC supply voltage for TFT-LCD panel driving.

The TFT-LCD panel used for this module has very high aperture ratio. A low-reflection and higher-color-saturation type color filter is also used for this panel. Therefore, high-brightness and high-contrast image, which is suitable for the LCD TV,HDTV and multimedia use, can be obtained by using this module.

[Features]

- A Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Filament Lamp (CCFL) backlight system.
- TFT as the active element.
- Associated electronics (drivers, control circuits, etc)
- A metal frame

3. General Specifications

Parameter	Specifications	Unit
Display size	380.16 (15.0") Diagonal	mm
Active area	304.128 (H)×228.096 (V)	mm
Pixel format	1024 (H)×768 (V) (1 pixel = R+G+B dots)	Pixel
Pixel pitch	0.297 X 0.297	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally White	
Unit outline dimensions	326.5(W)×253.5 (H)	mm
Thickness	Typ. 15. 4	mm
Weight	1500 max.	g
Surface treatment	Hard Coating (3H) & Anti-Glare (26%) treatment of the front polarizer	
Lamp Quantity	4 edge type CCFL	pcs

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +5V DC power supply)

Using connector: DF14H-20P-1.25H (Hirose) or Equivalent

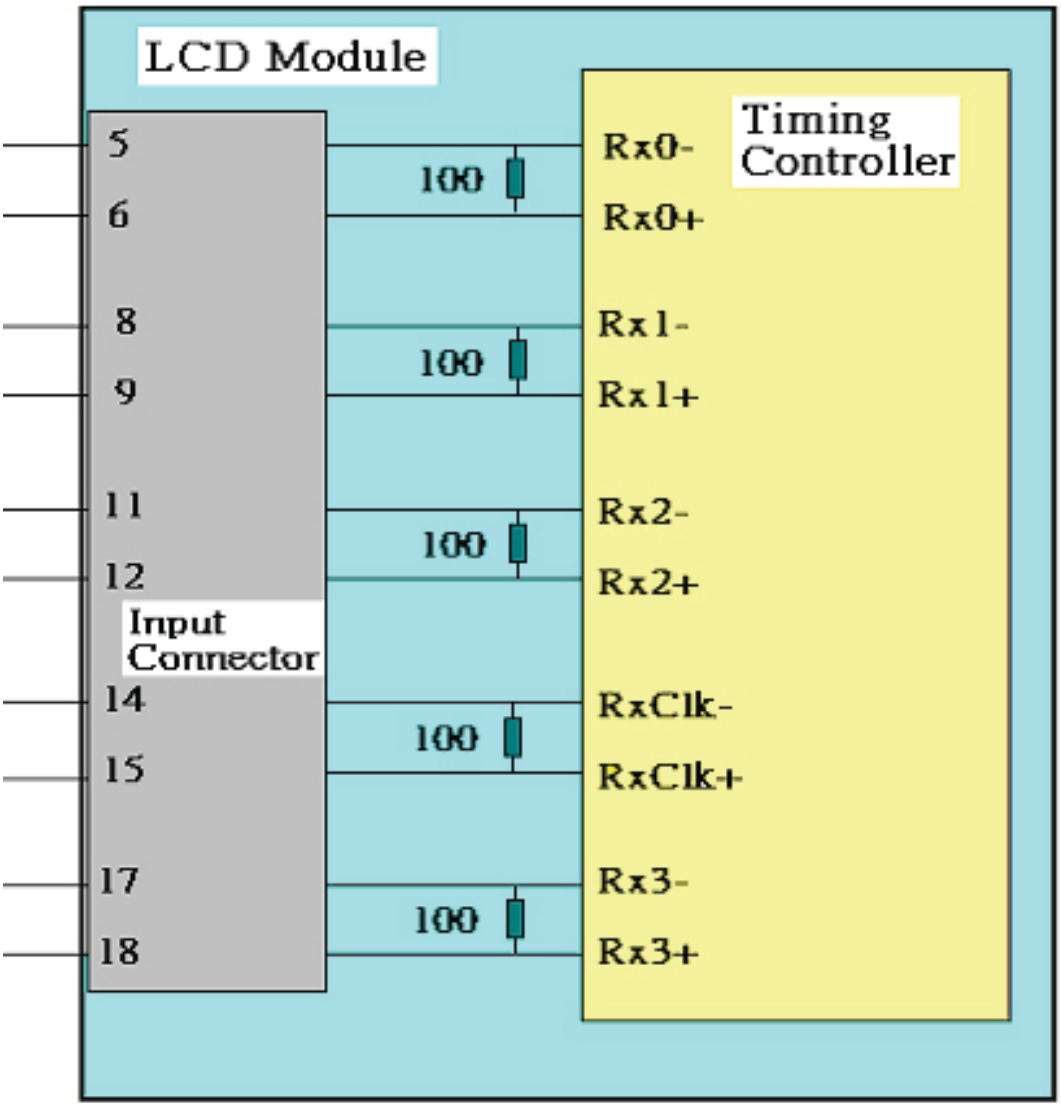
LCD Connector: DF14-20S-1.25C(Manufactured by Hirose) or Equivalent

Pin No.	Symbol	Function	Remark
1	VDD	+5V Input	
2	VDD	+5V Input	
3	GND	Power Ground	
4	GND	Power Ground	
5	RxIN0-	Receiver signal (-)	LVDS
6	RxIN0+	Receiver signal (+)	LVDS
7	GND	Ground	
8	RxIN1-	Receiver signal (-)	LVDS
9	RxIN1+	Receiver signal (+)	LVDS
10	GND	Ground	
11	RxIN2-	Receiver signal (-)	LVDS
12	RxIN2+	Receiver signal (+)	LVDS
13	GND	Ground	
14	CLKIN-	Clock signal (-)	LVDS
15	CLKIN+	Clock signal (+)	LVDS
16	GND	Ground	
17	RxIN3-	Receiver signal (-)	LVDS
18	RxIN3+	Receiver signal (+)	LVDS
19	GND	Ground	
20	GND	Ground	

【Note 1】All GND(ground) pins should be connected together.

【Note 2】All V_{DD} (power supply) pins should be connected together.

4-2 Interface block diagram



4-3. Backlight driving

Pin	Symbol	Description	Notes
1	HV	Power supply for lamp (high)	1) LCD : BHSR-02VS-1 (JST)
2	LV	Power supply for lamp (Low)	2) System : SM02B-BHSS-1 (JST)

5.Absolute Maximum Ratings

LCD module

Parameter	Symbol	Condition	Ratings	Unit	Remark
+5V supply voltage	V_{DD}	Ta=25℃	-0.3 ~ 6.0	V	
Storage temperature	Tstg	—	-20 ~ 60	℃	【Note1】
Operating temperature (Ambient)	Topa	—	0 ~ +50	℃	

【Note1】 Humidity : 90%RH Max. at Ta≦40℃.

Maximum wet-bulb temperature at 39℃ or less at Ta>40℃.

No condensation.

6. Electrical Characteristics

6-1.TFT-LCD panel driving

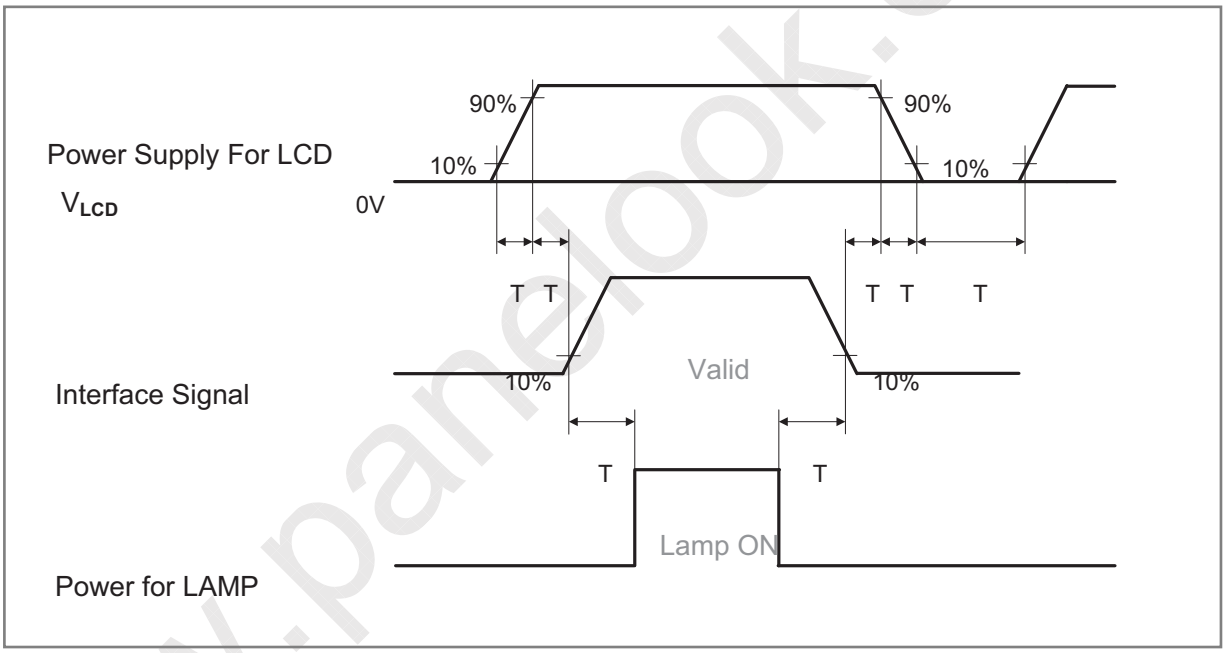
Ta＝25℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
V_{DD}	Supply voltage	V_{DD}	4.75	5.0	5.25	V	【Note2】
	Current dissipation	I_{DD}	-	430	550	mA	【Note3】
Permissive input ripple voltage		V_{RP}	-	-	100	mV p-p	V_{DD}=+5V
Differential input threshold voltage	High	V_{TH}	-	-	+100	mV	V_{CM}=+1.2V 【Note1】
	Low	V_{TL}	100	-	-	mV	
Rush current		I_{RUSH}	-	-	*2*	A	Rise time 200 uS

【Note1】 V_{CM} : Common mode voltage of LVDS driver.

【Note2】

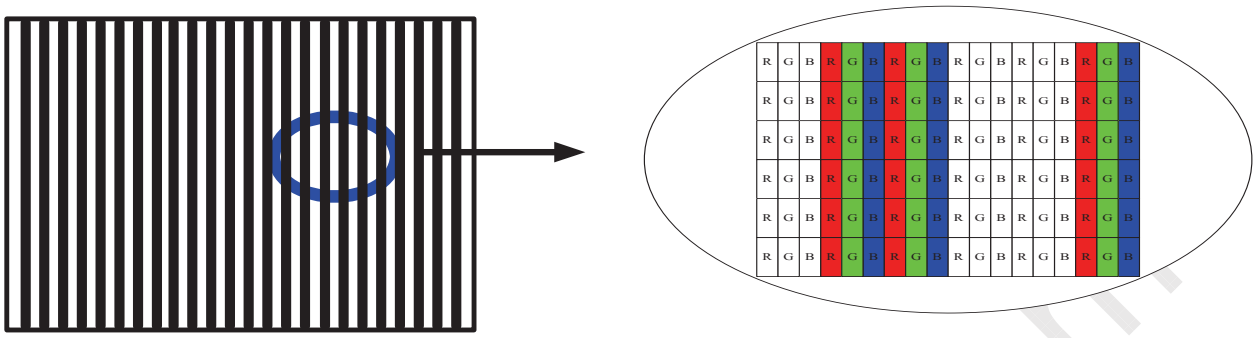
Power On-off sequence



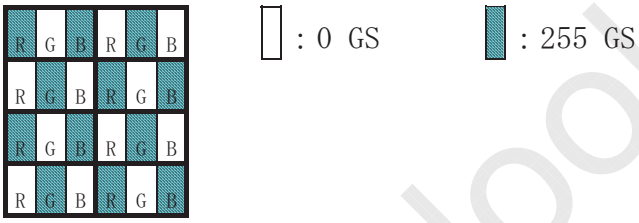
	Min	Max	Units
T1	1	10	ms
T2	0	50	ms
T3	200	-	ms
T4	200	-	ms
T5	0	50	ms
T6	0	10	ms
T7	400	-	ms

【Note3】

Typical current condition; 2-line vertical stripe pattern (0,255GS). V_{DD}=+5V



Maximum current condition; Change to 1x1 dot checker board pattern. V_{DD}=+5V

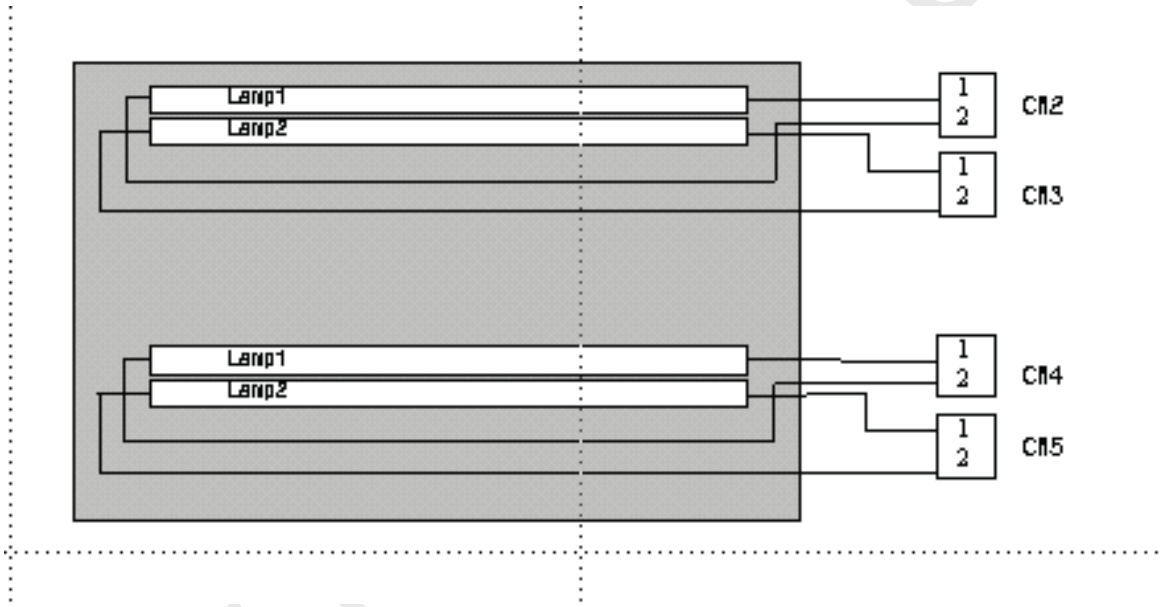


6-2. Backlight driving

The backlight system is a edge type with 4 CCFL lamp.

The characteristics of the lamp are shown in the following table.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current range	I_L	6.0-	7.0	7.5	mArms	【Note1】
Lamp voltage	V_L	-	585	-	Vrms	
Lamp power consumption	P_L	-	16.4	-	W	【 Note2 】 IL=7.0 mA
Lamp frequency	F_L	40-	60	80-	kHz	【Note3】
Established starting voltage	Vs	900	-		Vrms	Ta=25℃
		1150	-		Vrms	Ta=0℃ 【Note4】
Lamp life time	L_L	50,000	-		hour	【Note5】



【Note1】 Lamp current is measured with current meter for high frequency as shown below.

【Note2】 Calculated Value for reference ($I_L \times V_L$)

【Note3】 Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

【Note4】 The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise the lamp may not be turned on.

【Note5】 Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of Ta = 25℃ and I_L =7.0 mArms.

① Brightness becomes 50 % of the original value under standard condition.

② Kick-off voltage at Ta = 0℃ exceeds maximum value.

【Note6】 The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

【Note7】 The lamp wire length is +/- mm(from AL back cover surface to connector, not including connector length)

7. Timing characteristics of LCD module input signals

7-1. Timing characteristics

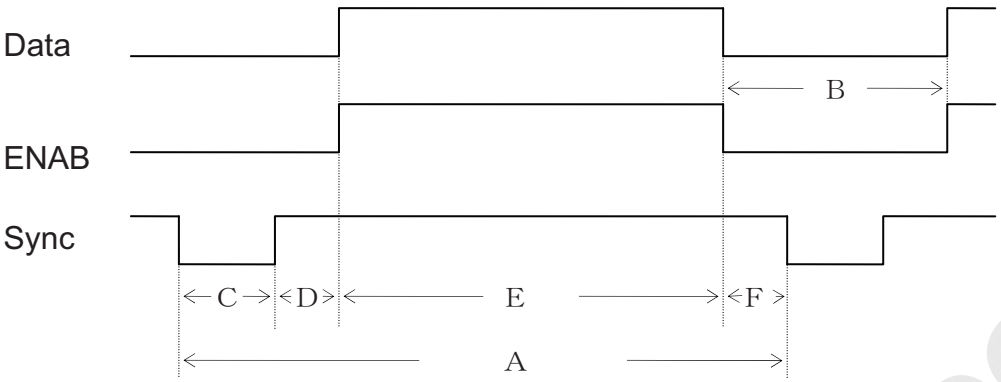
(This is specified at digital outputs of LVDS driver.)

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	t_{CLK}	12.70	15.38	20.00	ns	
	Frequency	-	55	65	78.75	MHz	
Hsync	Period	t_{HP}	1360	1344	1312	t_{CLK}	
	Width	t_{WH}	30	136	96-	t_{CLK}	
Vsync	Period	t_{VP}	860	806	800	t_{HP}	PAL : 47~53Hz
	Frequency	f_V	47	60	75	Hz	NTSC : 57~63Hz
	Width	t_{WV}	10	6	3	t_{HP}	
DE (Data Enable)	Horizontal Valid	t_{HV}	1024	1024	1024	t_{CLK}	
	Horizontal Back Porch	t_{HBP}	198	160	176		
	Horizontal Front Porch	t_{HFP}	108	24	16		
	-	-	-	-	-		
	Vertical Valid	t_{VV}	768	768	768	t_{HP}	
	Vertical Back Porch	t_{VBP}	56	29	28		
	Vertical Front Porch	t_{VFP}	26	3	1		
	-	-	-	-	-		

Notes : 1.The performance of electro-optical characteristics may be influenced by variance of the vertical refresh rate.

2. Hsync period will be a double number of character (8).

7-2 Signal Timing Waveform



8. Input Signals, Basic Display Colors and Gray Scale of Each Color

	Colors &	Data Signal																							
	Gray scale	R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
Basic Color	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	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	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 Scale of Red	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
	⇧	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧				↓								↓								↓				
	⇩				↓								↓								↓				
	Bright	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	0	1	1	1	1	1	1	1	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	0
Gray Scale of Green	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
	⇧	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧																								
	⇩																								
	Bright	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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	0
Gray Scale of Blue	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
	⇧	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧																								
	⇩																								
	Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage, 1 : High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. According to the combination of total 24 bit data signals, the 16.2M-color display can be achieved on the screen.

9. Optical Characteristics

Ta=25℃, V_{DD}=+5V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	L/R	θ 21, θ 22	CR>10	TBD	70		Deg.	【Note1,4】
	U	θ 11		TBD	65		Deg.	
	D	θ 12		TBD	60		Deg.	
Contrast ratio		CRn	θ =0°	450	500	—		【Note2,4】
Response time		τ		—	16		ms	【Note3,4】
Rise time	τ r				TBD		ms	
Fall time	τ d				TBD		ms	
Chromaticity of White (CIE 1931)		Wx		0.259	0.289	0.319		【Note4】
		Wy		0.274	0.304	0.334		
Chromaticity of Red (CIE 1931)		Rx		0.589	0.619	0.649		
		Ry		0.313	0.343	0.373		
Chromaticity of Green (CIE 1931)		Gx		0.268	0.298	0.328		
		Gy		0.548	0.578	0.608		
Chromaticity of Blue (CIE 1931)		Bx		0.119	0.149	0.179		
		By		0.052	0.082	0.112		
Luminance of white 【Note4】		Y_L		TBD	450		Cd/m^2	
White Uniformity		δ w		—	-	1.3		【Note5】

※ The measurement shall be executed 30 minutes after lighting at rating. (typical condition : I_L = 7.0mArms)

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.1 below.

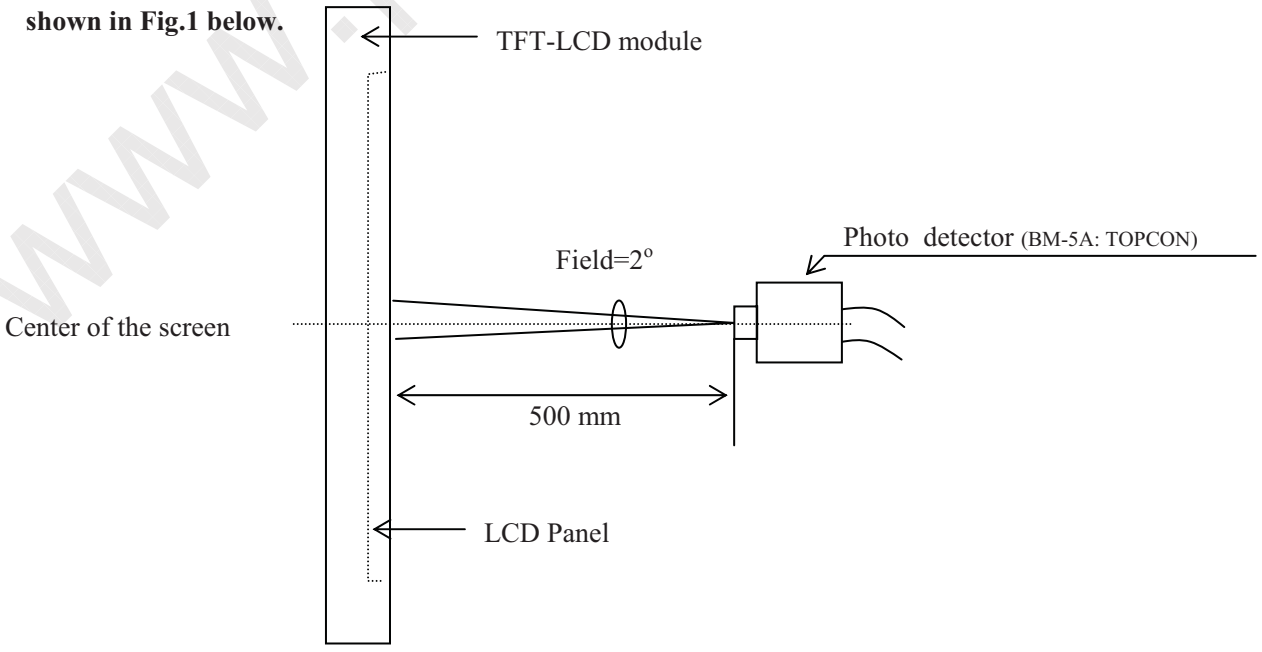
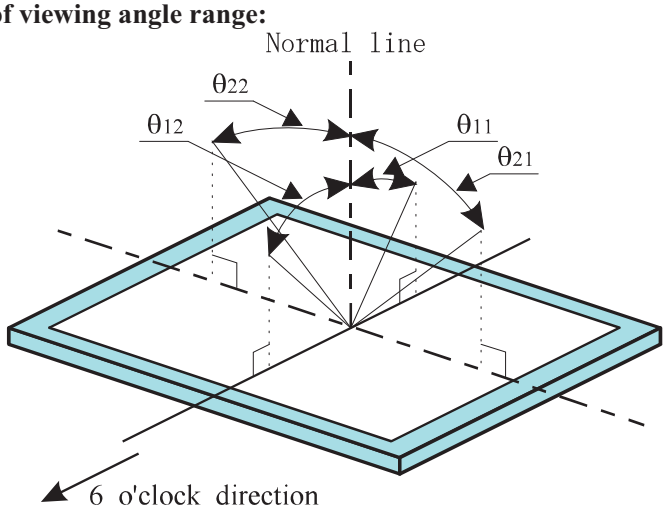


Fig 1. Optical characteristics measurement method

【Note1】 Definitions of viewing angle range:



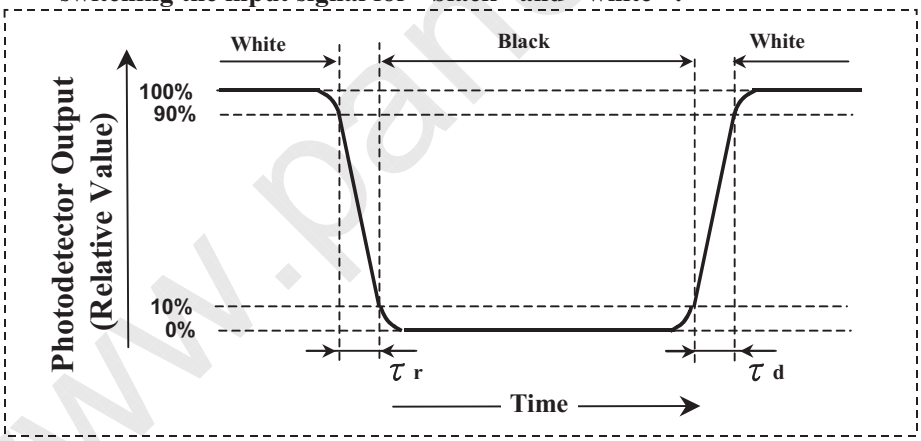
【Note2】 Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

【Note3】 Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .

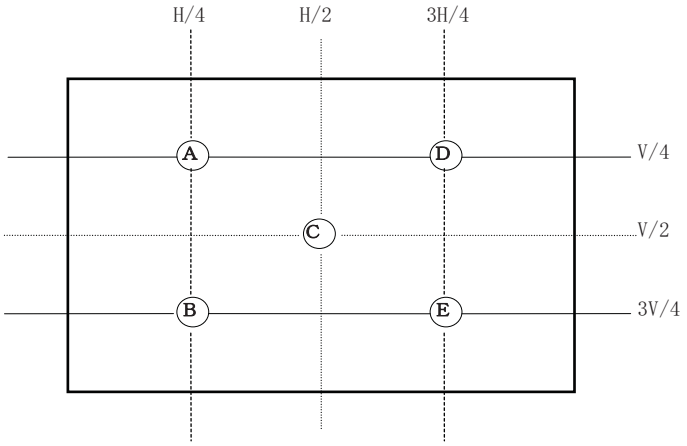


【Note4】 This shall be measured at center of the screen.

【Note5】 Definition of white uniformity:

White uniformity is defined as the following with five measurements

(A～E).HxV : active area



$$\delta_W = \frac{\text{Maximum Luminance (of 5 points measurement)}}{\text{Minnum Luminance (of 5 points measurement)}}$$

10. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

11. Handling Precautions

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

c) Since the front polarizer is easily damaged, pay attention not to scratch it.

d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.

h) Observe all other precautionary requirements in handling components.

i) This module has its circuitry PCBs on the rear side and should be handled carefully in order not to be stressed.

j) Laminated film is attached to the module surface to prevent it from being scratched . Peel the film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc..

k) The LCD Module shall be supplied by power complied to International Standards (IEC60950 or UL60950).

12.Reliability test items

The display module must operate error free when operated under the following environmental test condition.

No	Test Item	Condition
1	High Temperature storage test	Ta=60^{0}C 240 hours
2	Low Temperature storage test	Ta=-20^{0}C 240 hours
3	High Temperature operation test	Ta=50^{0}C 50%RH 240 hours
4	Low Temperature operation test	Ta=0^{0}C 240 hours
5	Vibration Test (Non-Operating)	Waveform: Random Vibration level: 1.0G RMS Bandwidth: 10-500Hz Duration: X,Y,Z, 20 min One time in each direction
6	Shock Test (Non-Operating)	Shock level: 100G Waveform: half sine wave, 2mS Direction: ±X, ±Y, ±Z One time in each direction

13. Others

1) Adjusting volume has been set optimally before shipment, so do not change any adjusted value.

If adjusted value is changed, the technical literature may not be satisfied.

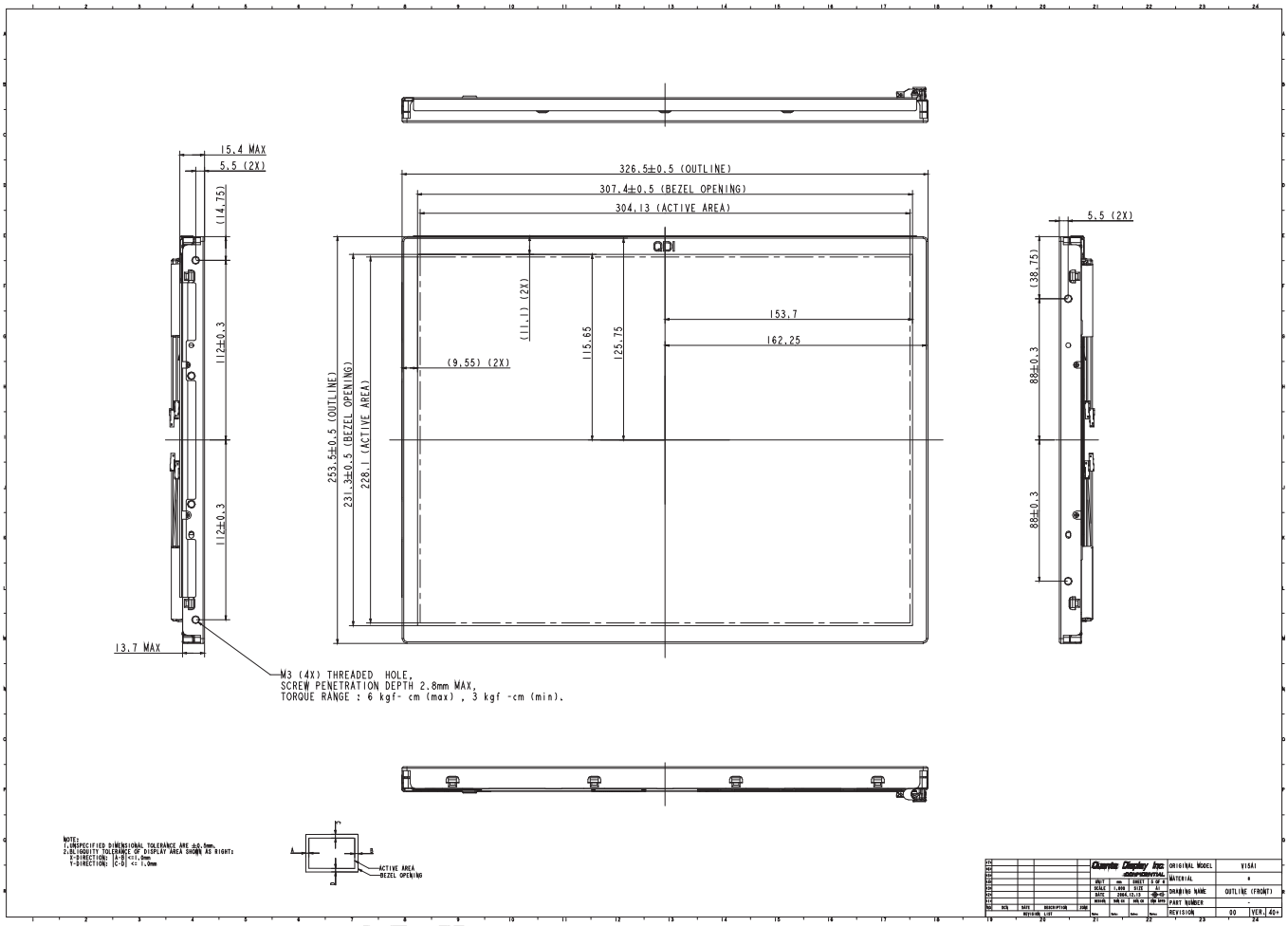
2) Disassembling the module can cause permanent damage and should be strictly avoided.

3) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.

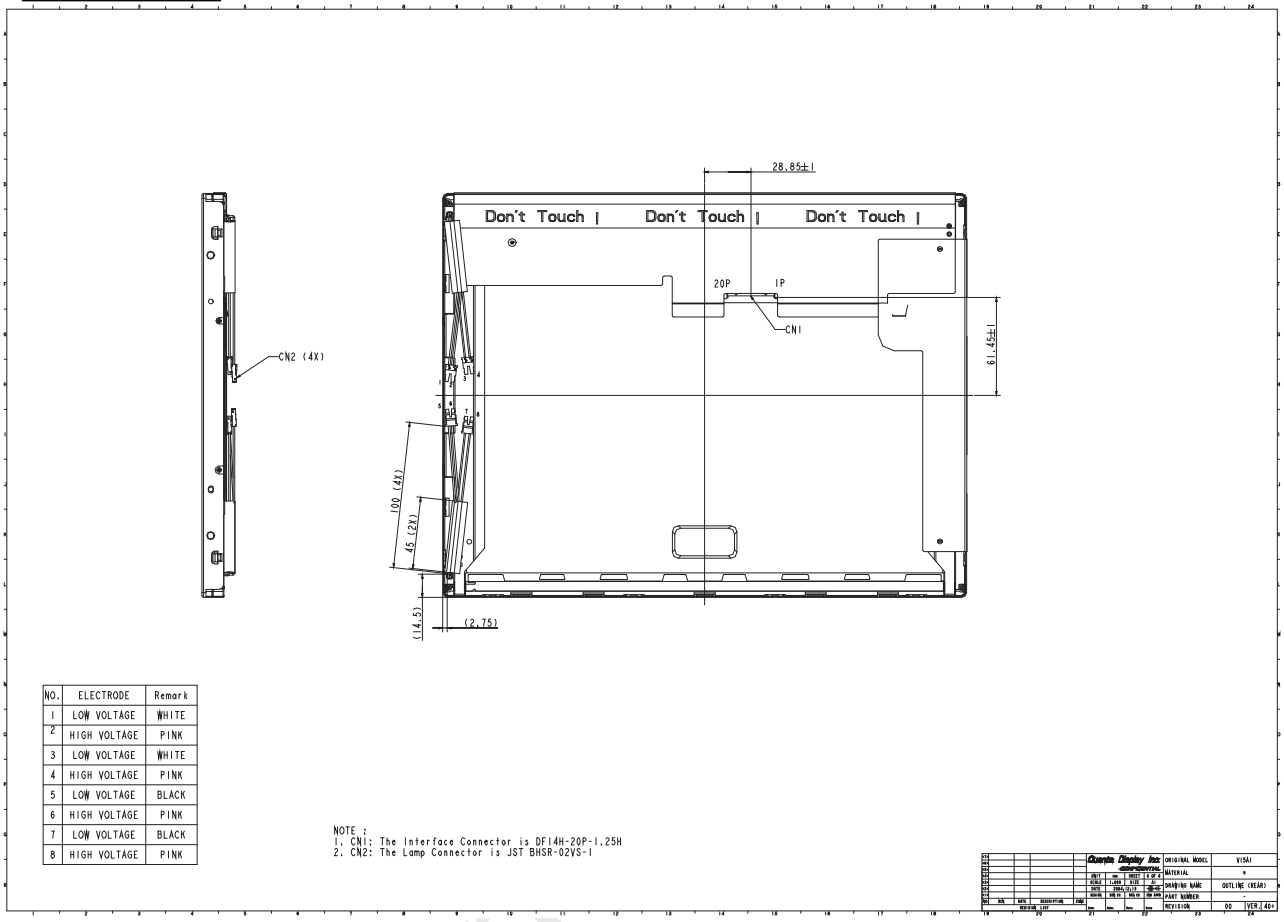
4) If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.

14. Drawing

Front View



Back View



NO.	ELECTRODE	Remark
1	LOW VOLTAGE	WHITE
2	HIGH VOLTAGE	PINK
3	LOW VOLTAGE	WHITE
4	HIGH VOLTAGE	PINK
5	LOW VOLTAGE	BLACK
6	HIGH VOLTAGE	PINK
7	LOW VOLTAGE	BLACK
8	HIGH VOLTAGE	PINK

NOTE :
1. CN1: The Interface Connector is DF14H-20P-1.25H
2. CN2: The Lamp Connector is JST BHSR-02VS-1