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

Specification for
TFT LCD Module

Model No. QD23WL04 REV:01

☐ **Customer's Approval**

Date _____

by _____

Approved By _____

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Revision History			
REV.	Date	ECN NO.	Change Content
1	11/07/2003	N/A	Preliminary specification Initiate
2	12/12/2003	N/A	Page 14, timing change.

Content List

1. Application

This specification applies to a color TFT-LCD module, QD23WL04

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 1280×3×768 dots panel with 16.7 million colors by using the LVDS (Low Voltage Differential Signaling) interface, 8-bit driving method and supplying +12V 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]

1) High aperture panel; high-brightness
2) Brilliant and high contrast image.
3) High speed response
4) WXGA resolution. 15:9
5) LVDS interface.
6) ASV technology
7) Wide viewing angle.

3. General Specifications

Parameter	Specifications	Unit
Display size	58.44 (23") Diagonal	cm
Active area	501.12 (H)×300.67 (V)	mm
Pixel format	1280 (H)×768 (V)	Pixel
	(1 pixel = R+G+B dots)	
Pixel pitch	0.3915 (H) × 0.3915 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally Black	
Unit outline dimensions	528 x 326	mm
Thickness	Max. 38.6	mm
Weight	Max. 2700	g
Surface treatment	Anti-glare and hard-coating 3H	
Lamp Quantity	12	pcs

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +12V DC power supply)

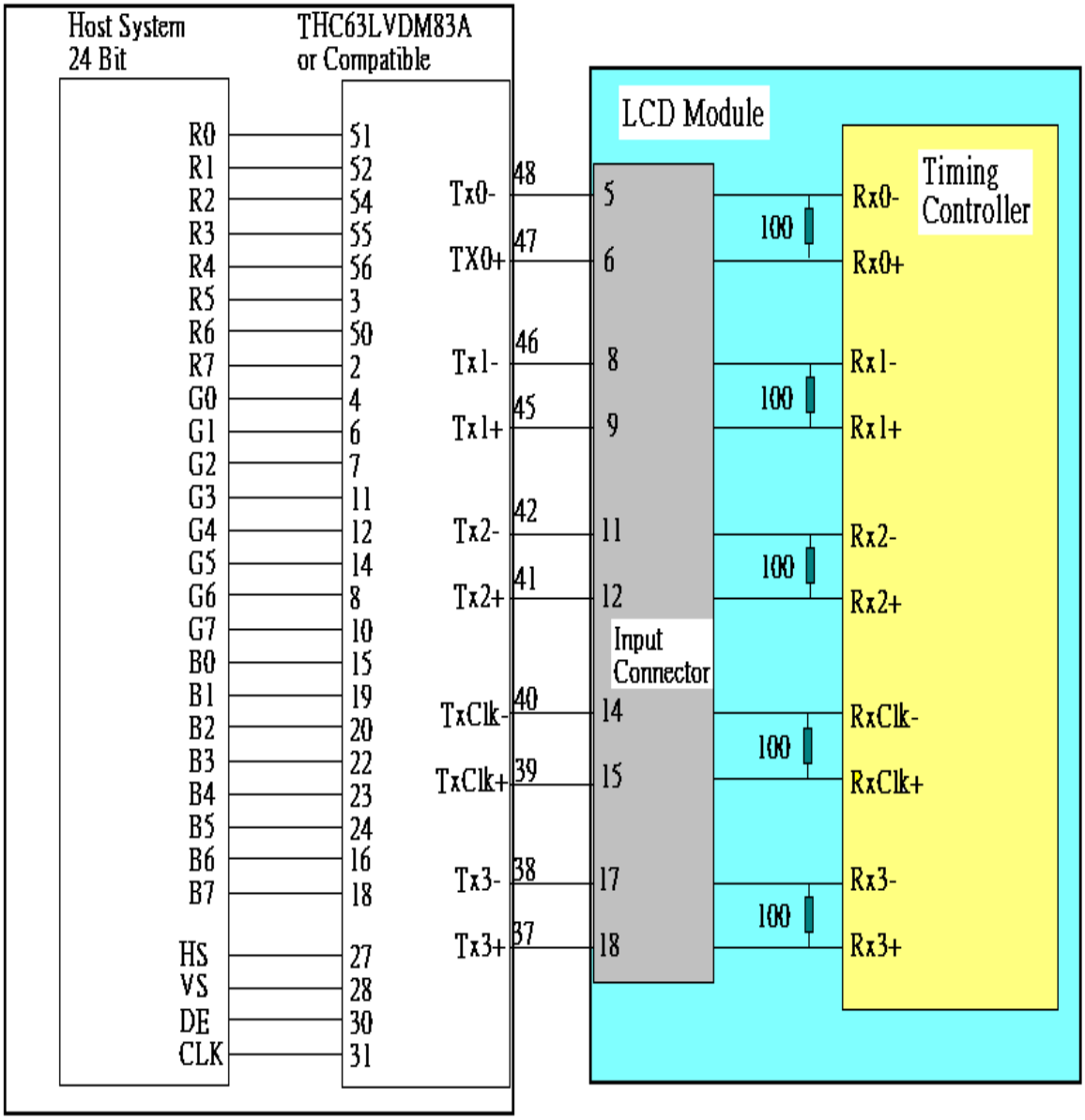
Using connector: DF14-20P-1.25H (Hirose) or Equivalent

Pin No.	Symbol	Function	Remark
1	VDD	+12V Input	
2	VDD	+12V 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

Connector	Type	Manufactured
CN1	S12B-PH-SM3-TB	JST
CN2	SM02(12)B-BHS-1-TB	JST
CN3	DF-13-3P-1.25H	Hirose

5.Absolute Maximum Ratings

LCD module

Parameter	Symbol	Condition	Ratings	Unit	Remark
+12V supply voltage	V_{DD}	Ta=25℃	-0.3 ～ +14.0	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

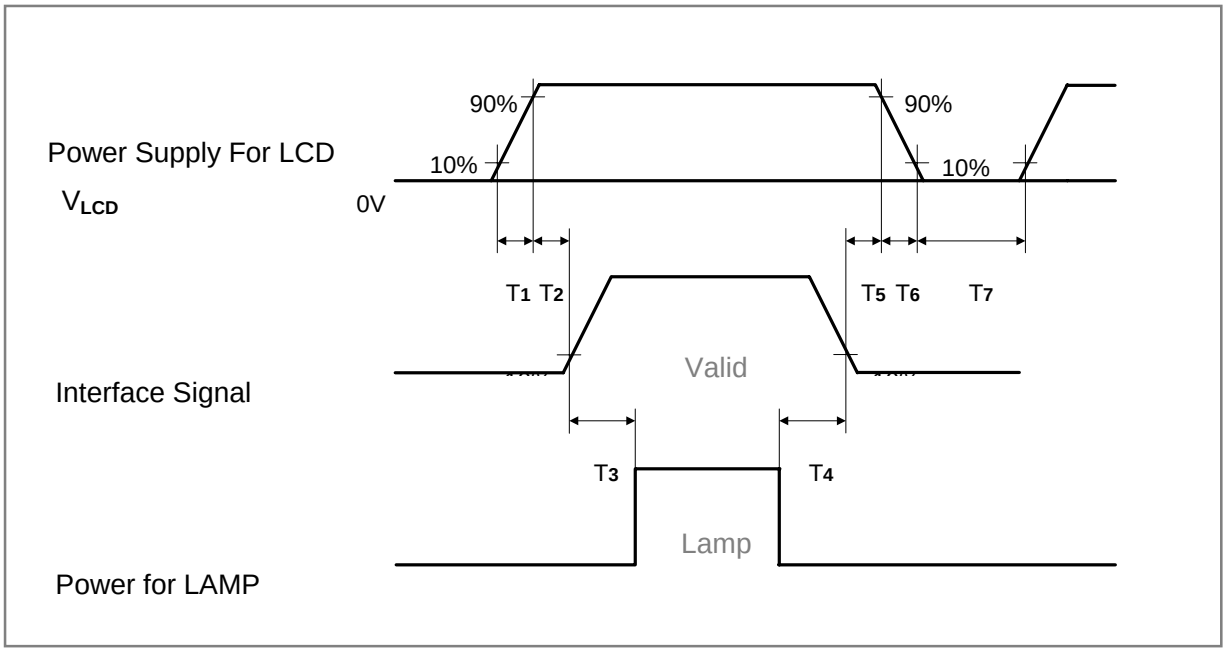
Ta＝25℃

Parameter			Symbol	Min.	Typ.	Max.	Unit	Remark
V_{DD}	Supply voltage		V_{DD}	+11.4	+12.0	+12.6	V	【Note2】
	Current dissipation		I_{DD}	—	*250*	*350*	mA	【Note3】
Permissive input ripple voltage			V_{RP}	—	—	120	mV p-p	V_{DD}=+12V
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 470uS

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

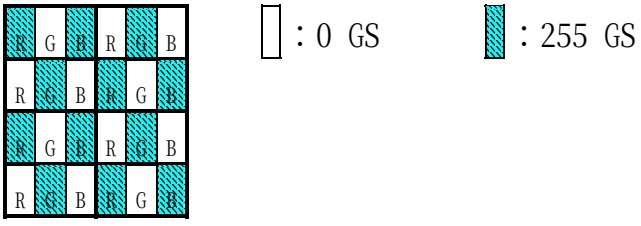
【Note2】

Power On-off sequence



1ms＜T1,T6≦10 ms　　0.5ms＜T2,T5≦50 ms　　200ms＜T3,T4　　T7＞1 s

【Note3】 Maximum current condition; Change to 1x1 dot checker board pattern. V_{DD}=+12V



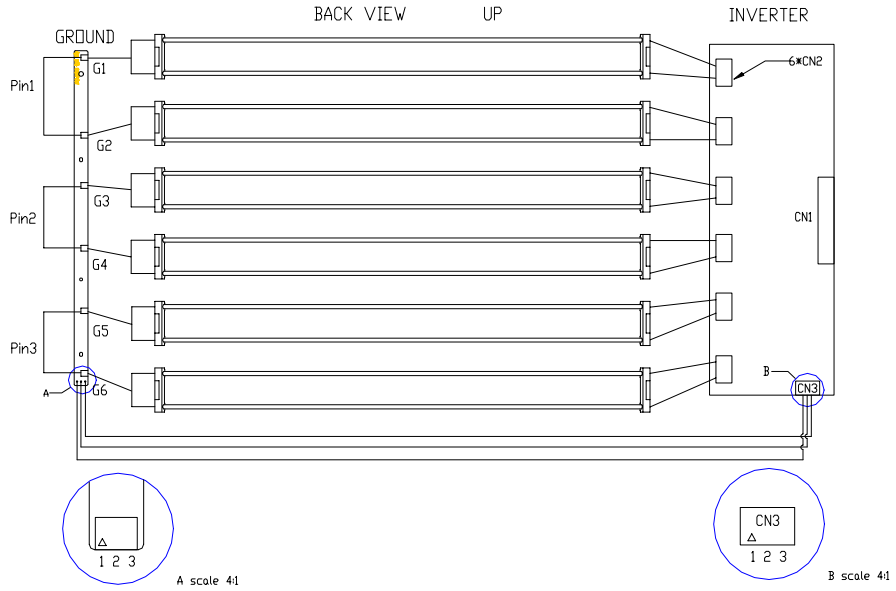
6-2. Backlight driving

The backlight system is a direct-lighting type with 12 CCFT (Cold Cathode Fluorescent Tube).

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current range	I_L		4.2		mArms	【Note1】
Lamp voltage	V_L	*792*	880	*968*	Vrms	
Lamp power consumption	P_L		3.7		W	【Note2】IL=4.2mA
Lamp frequency	F_L	*52*		*55*	kHz	【Note3】
Established starting voltage	Vs			1200	Vrms	Ta=25℃
				1600	Vrms	Ta=0℃ 【Note4】
Lamp life time	L_L	50000			hour	【Note5】

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



【Note2】 **Calculated Value for reference (I_L × 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 =4.2 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 19+/-1mm(from AL back cover surface to connector, not including connector length)

6-3 Backlight inverter

6-3-1 Backlight inverter connector and pin assignments

Inverter connector CN1 : S12B-PH-SM3-TB (JST) or Equivalent

Mating connector : PHR-12(JST) or Equivalent

CN1 : Inverter connector pin assignments

Pin No.	Symbol	Description	Remark
1	VDD	Power Input +24V	
2	VDD	Power Input +24V	
3	VDD	Power Input +24V	
4	NC	Not connection	
5	PWSEL	Select of luminance control signal method	See Luminance Control
6	BRTP	PWM signal	See Luminance Control
7	BRTI	Luminance by voltage method	See Luminance Control
8	BRTC	Backlight On/OFF signal	High : On , Low: Off
9	NC	Not connection	
10	GND	Ground	Connected to metal frame
11	GND	Ground	
12	GND	Ground	

6-3-2. Inverter Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Power Supply Input Voltage	V_{DDB}		24		Vdc	
Power Supply Input Current	I_{DDB}		2160		mA	TBD
Power Consumption	P_B		51.84		W	TBD

6.4 Luminance Controls

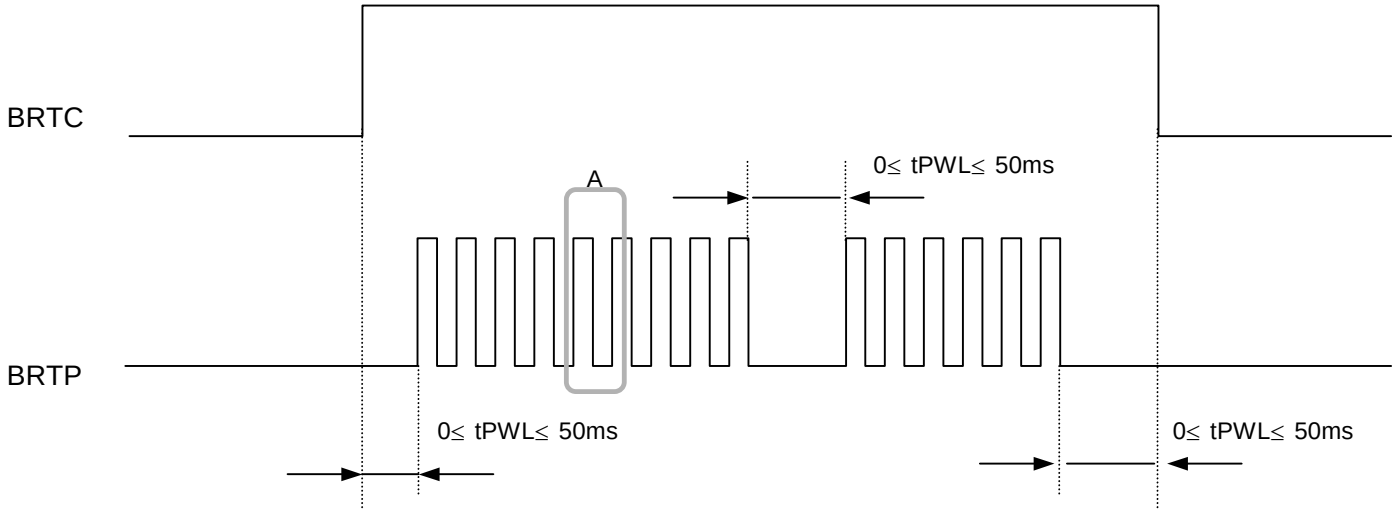
Method	Adjustment and Luminance Ratio	PWSEL	BRTP	Remark
Voltage control	Adjustment – Continuous adjustment of Luminance by adjusting the voltage of BRTI within the rated range.	High	Open	

<table>
<tr><td></td><td><table><tr><td>BRTI voltage</td><td>Luminance ratio</td></tr><tr><td>0V</td><td>20%(minimum)</td></tr><tr><td>3.3V</td><td>100% (maximum)</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>PWM control</td><td>Adjustment- The luminance is controlled by duty ratio of BRTP signal when PWSEL is low and PWM signal is inputted into BRTP termial.<table><tr><td>Duty Ratio</td><td>Luminance Ratio</td></tr><tr><td>0.2</td><td>20%(minimum)</td></tr><tr><td>1.0</td><td>100% (maximum)</td></tr></table></td><td>Low</td><td>PWM signal</td><td>See PWM timing</td></tr>
</table>

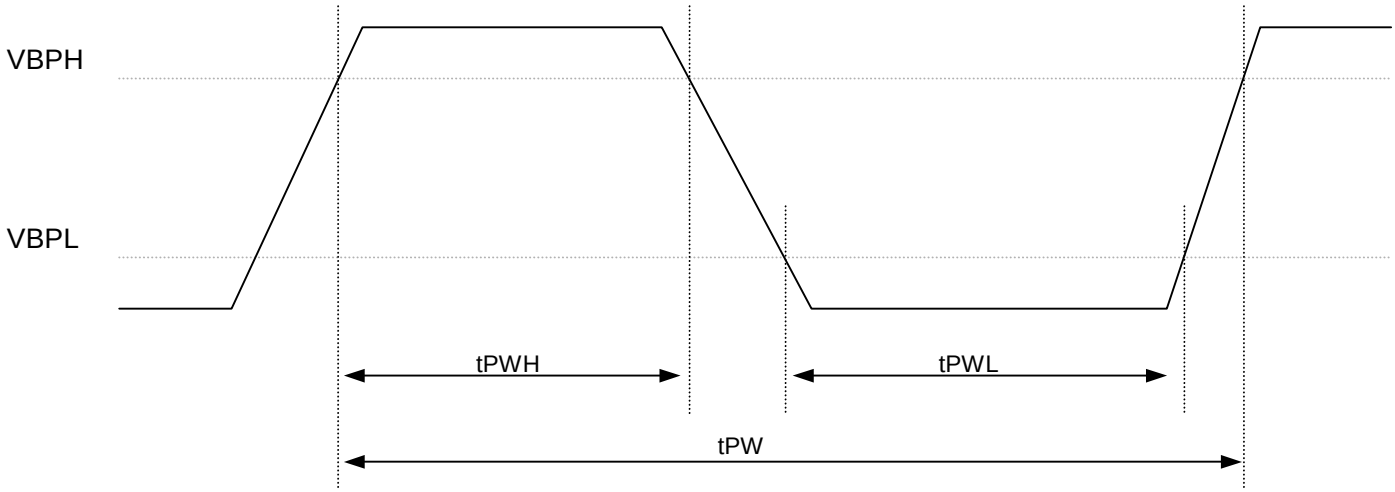
6-5. PWM timing

6-5-1. Timing diagram

- Outline chart



- Detail of A part



6-5-2. Each parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Luminance control fequency	FL	230	255	280	Hz	1, 2
Duty Ratio	DL	0.2	-	1.0	-	1, 3
Non signal Period	tPWL	0	-	50	Ms	4

Notes : 1. Definition of parameters is as follows

$$FL=\frac{1}{tPW} \quad , \quad DL=\frac{tPWH}{tPW}$$

2. See the following formula for luminance control frequency.

Luminance control frequency = tvv X (n+0.25)[or(n+0.72)]

n=1,2,3,……

tvv : See “7.1 Signal timing specification”

The interference noise of luminance control frequency and input signal frequency for LCD panel signal processing board may appear on a display. Set up luminance control frequency so that the interference noise does not appear.

3. See “6.4 Luminance control methods”
4. If tPWL is more than 50ms, the backlight will be turned off by a protection circuit for inverter.

7. Timing characteristics of LCD module input signals

7-1. Timing characteristics

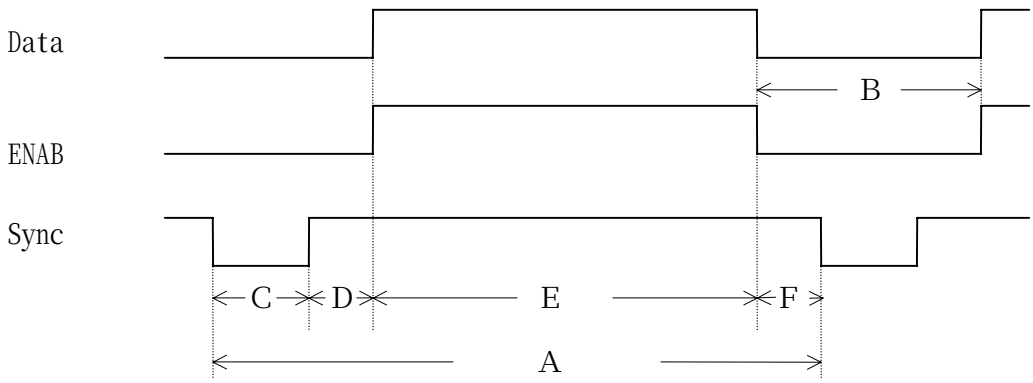
(This is specified at digital outputs of LVDS driver.)

Item	Symbol		Min	Typ	Max	Unit	Remark
Data Clock	Period	t_{CLK}	12.2	12.5	-	ns	
	Frequency	F_{CLK}	-	80	82	MHZ	
Hsync	Period	t_{HA}	1337	1648	1780	tCLK	
	Frequency	fH	44.0	48.54	52	KHZ	
	Width	t_{HC}	8	16	-	tCLK	
Vsync	Period	t_{VA}	774	810	-	t_{HA}	NTSC: 57~63HZ
	Frequency	f_V	47	60	63	HZ	PAL: 47~53HZ
	Width	t_{VC}	2	6	-	t_{HA}	
DE (Data Enable)	Horizontal Valid	t_{HE}	1280	1280	1280	t_{CLK}	
	Horizontal Back Porch	t_{HD}	8	80	-		
	Horizontal Front Porch	t_{HF}	16	272	-		
	Horizontal Blank	t_{HB}	57	368	-		
	Vertical valid	t_{VE}	768	768	768	t_{HA}	
	Vertical Back Porch	t_{VD}	2	20	-		
	Vertical Front Porch	t_{VF}	2	16	-		
	Vertical Blank	t_{VB}	6	42	-		

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(The time "B" is t_{HB} on horizontal timing and t_{VB} on vertical timing)



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

	Colors & Gray scale	Data Signal																			
		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

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	85	88		Deg.	【Note1,4】
	U	θ 11		85	88		Deg.	
	D	θ 12		85	88		Deg.	
Contrast ratio		CRn	θ =0 °	500	600	—		【Note2,4】
Response time		τ		—	21		ms	【Note3,4】
Rise time	τ r				15		ms	
Fall time	τ d				6		ms	
Chromaticity of White (CIE 1931)		Wx		0.247	0.277	0.307		【Note4】
		Wy		0.264	0.294	0.324		
Chromaticity of Red (CIE 1931)		Rx		0.611	0.641	0.671		
		Ry		0.312	0.342	0.372		
Chromaticity of Green (CIE 1931)		Gx		0.245	0.275	0.305		
		Gy		0.583	0.613	0.643		
Chromaticity of Blue (CIE 1931)		Bx		0.117	0.147	0.177		
		By		0.040	0.070	0.100		
Luminance of white 【Note4】		Y_L		350	450		Cd/m^2	
White Uniformity		δw		—	-	1.25		【Note5】

※ The measurement shall be executed 30 minutes after lighting at rating. (typical condition : I_L = 4.2 mArms)

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

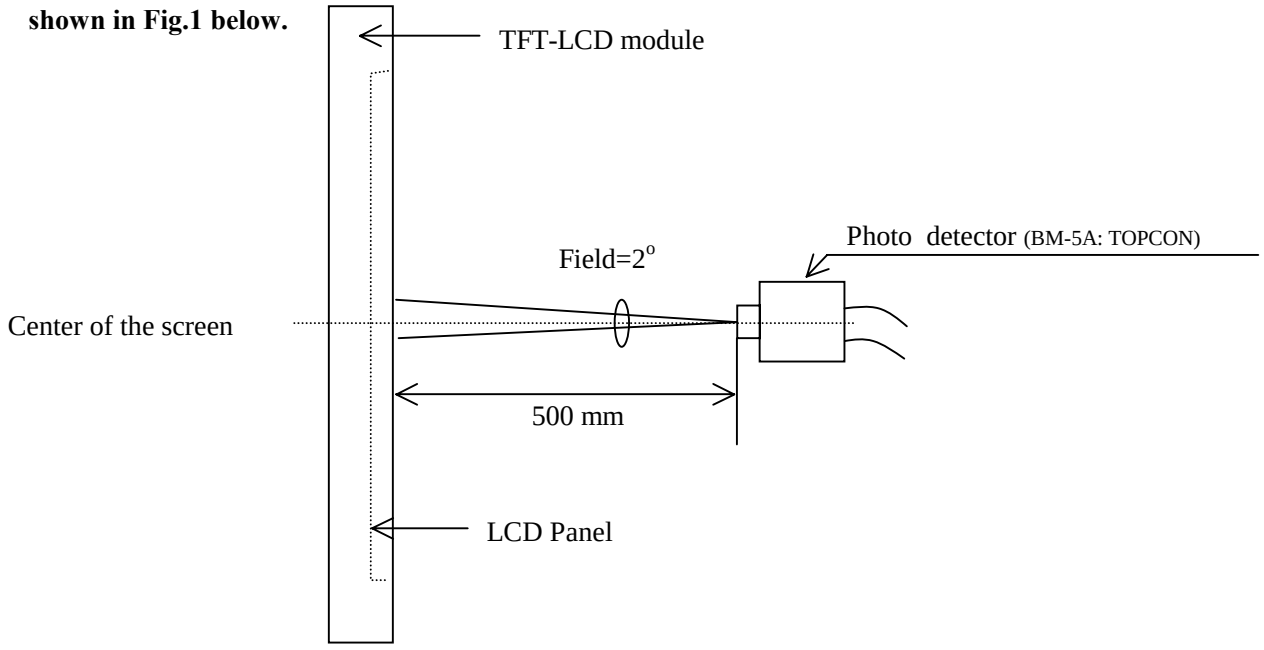
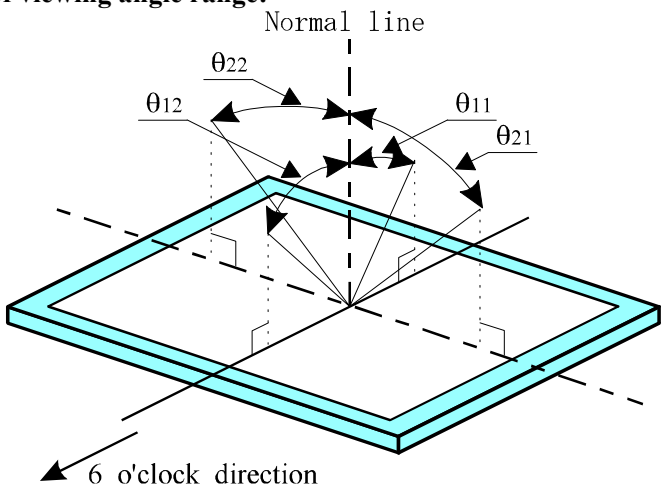


Fig 1. Optical characteristics measurement method

【Note1】 **Definitions of viewing angle range:**



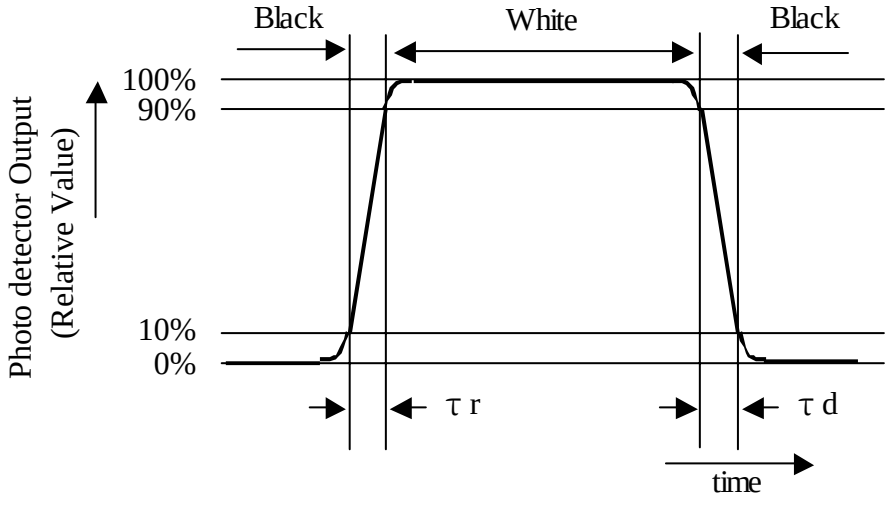
【Note2】 **Definition of contrast ratio:**

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:**

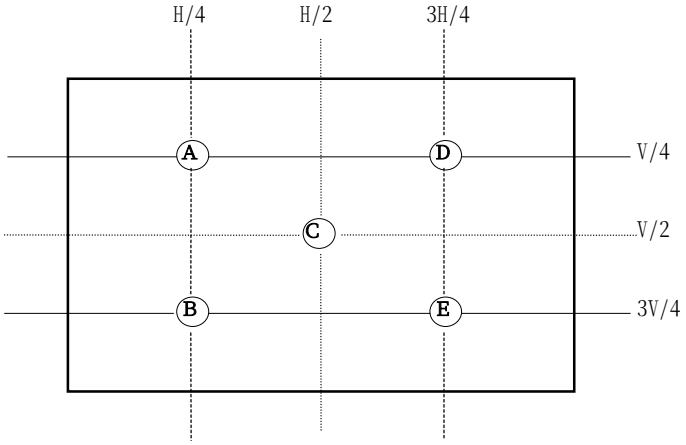
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



【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.

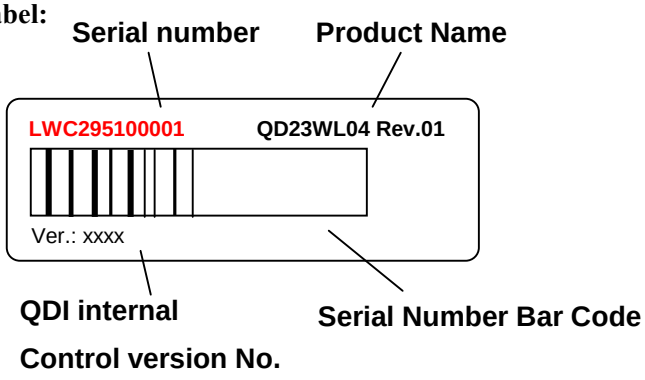
j) Laminated film is attached to the module surface to prevent it from being scratched . Peel the film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun,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

12.Reliability test items

No.	Test item	Conditions
1	High temperature storage test	Ta = 70℃ 240h
2	Low temperature storage test	Ta =-30℃ 240h
3	High temperature & high humidity operation test	Ta = 50℃ ; 95 %RH 240h
4	High temperature operation test	Ta = 60℃ 240h
5	Low temperature operation test	Ta = 0℃ 240h
6	Vibration test (non- operating)	Frequency: 10～500Hz, 1.2G , 1 Hr/each axis
7	Shock test (non- operating)	Gravity : 100G Pulse width : 2ms, half sine wave Direction : ±X,±Y,±Z Once for each direction.
8	ESD	Contact-op:+-8kv, Contact-nop: +-10kv, Air-op:+-15kv, Air-nop: +-20kv, (contact area is limited on metal bezel)

13. Others

1) Lot No. Label:



LWC295100001 **Digital code 4, 5 is Date code.**

Digital 4 (Year) 1: 2001, 2: 2002, 3:2003,….

Digital 5 (Month) 1: Jan, 2: Feb,… , A:Oct, B:Nov., C: Dec.

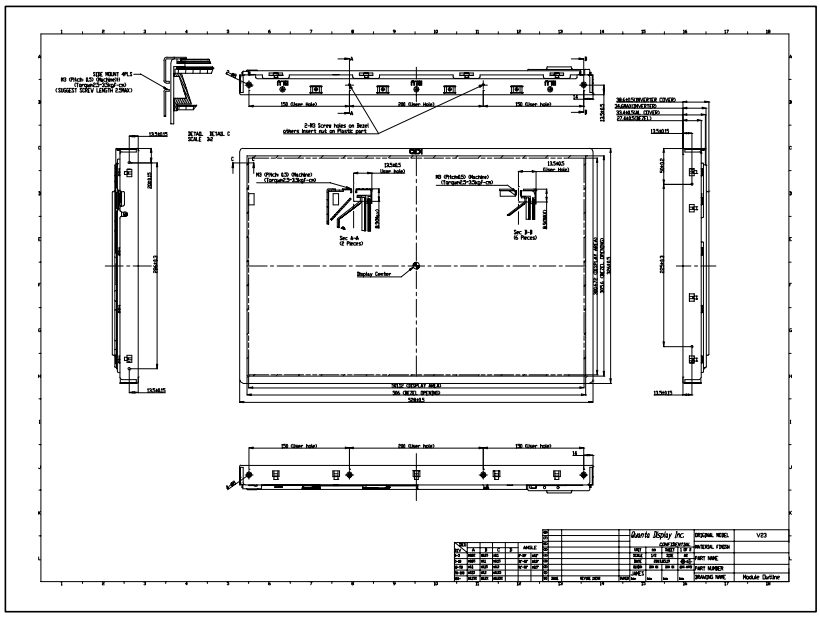
2) Adjusting volume has been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.

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

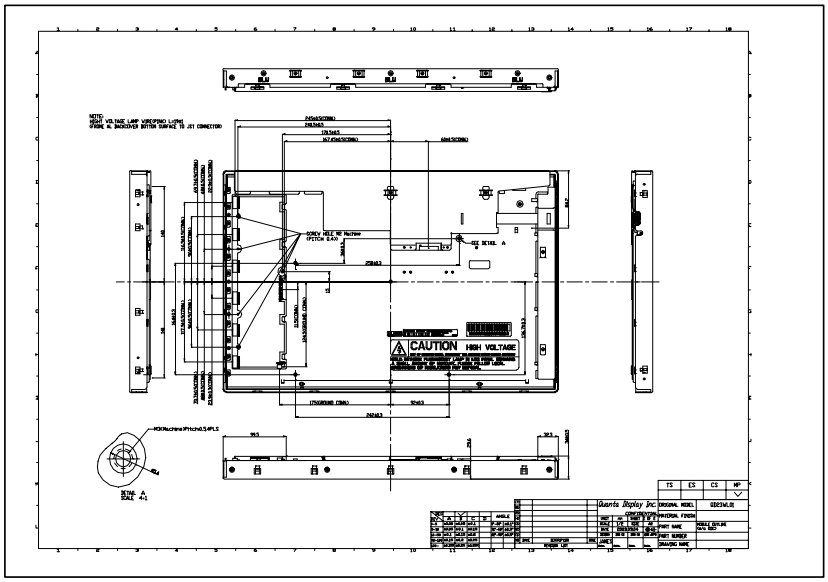
4) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.

5) 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