'REPARED BY : DATE	SHARP	SPEC No. LB-8333
		FILE No.
PPROVED BY : DATE		ISSUE : Apr. 12, 1996
	TENRI LCD DEVELOPMENT GROUP SHARP CORPORATION	PAGE : 17 pages
		APPLICABLE GROUP Tenri LCD Development Group
	SPECIFICATION	

DEVICE SPECIFICATION FOR

TFT-LCD Module

MODEL No.

LQ12X02

❑ CUSTOMER' S APPROVAL

DATE

BY

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RECORDS OF REVISION

LQ12X02

SPEC No.	DATE	REVISED No.	S W Y	NOTE
LD-8333	Apr. 12, 1996			1st Issue

The device listed in these specification 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.

SHARP 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 specification sheets.

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

1. Application

This specification applies to a color TFT-LCD module, LQ1 2X02.

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 1024X3X 768 dots panel with 262,144 colors by using LVDS (Low Voltage Differential Signaling) to interface and supplying +5V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The TFT-LCD panel used for this module has 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 multimedia use, can be obtained by using this module.

Optimum viewing direction is 6 o'clock.

Backlight-driving DC/AC inverter is not built in this module.

[Features]

1) High aperture panel ; high-brightness or low power consumption.
2) Brilliant and high contrast image.
3) Small footprint and thin shape.
4) Light weight.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	31 (Diagonal)	cm
	12.1 (Diagonal)	inch
Active area	245.8 (H) X 184.3 (V)	mm
Pixel format	1024 (H) X 768 (V)	pixel
	(1 pixel= R-1-G-t-B dots)	
Pixel pitch	0.24 (H) X 0.24 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	275 (W) X 199 (H) X 7.4 (D)	mm
Mass	490* 20	g
Surface treatment	Anti-glare and hard-coating 2H	

* 1.Note: excluding backlight cables and the edge of screws.

Outline dimensions is shown in Fig. 1

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +5V DC power supply)
Using connector : DF14A-20P-1.25H(Hirose Electric)
Corresponding connector : DF14-20S-1.25C (〃)

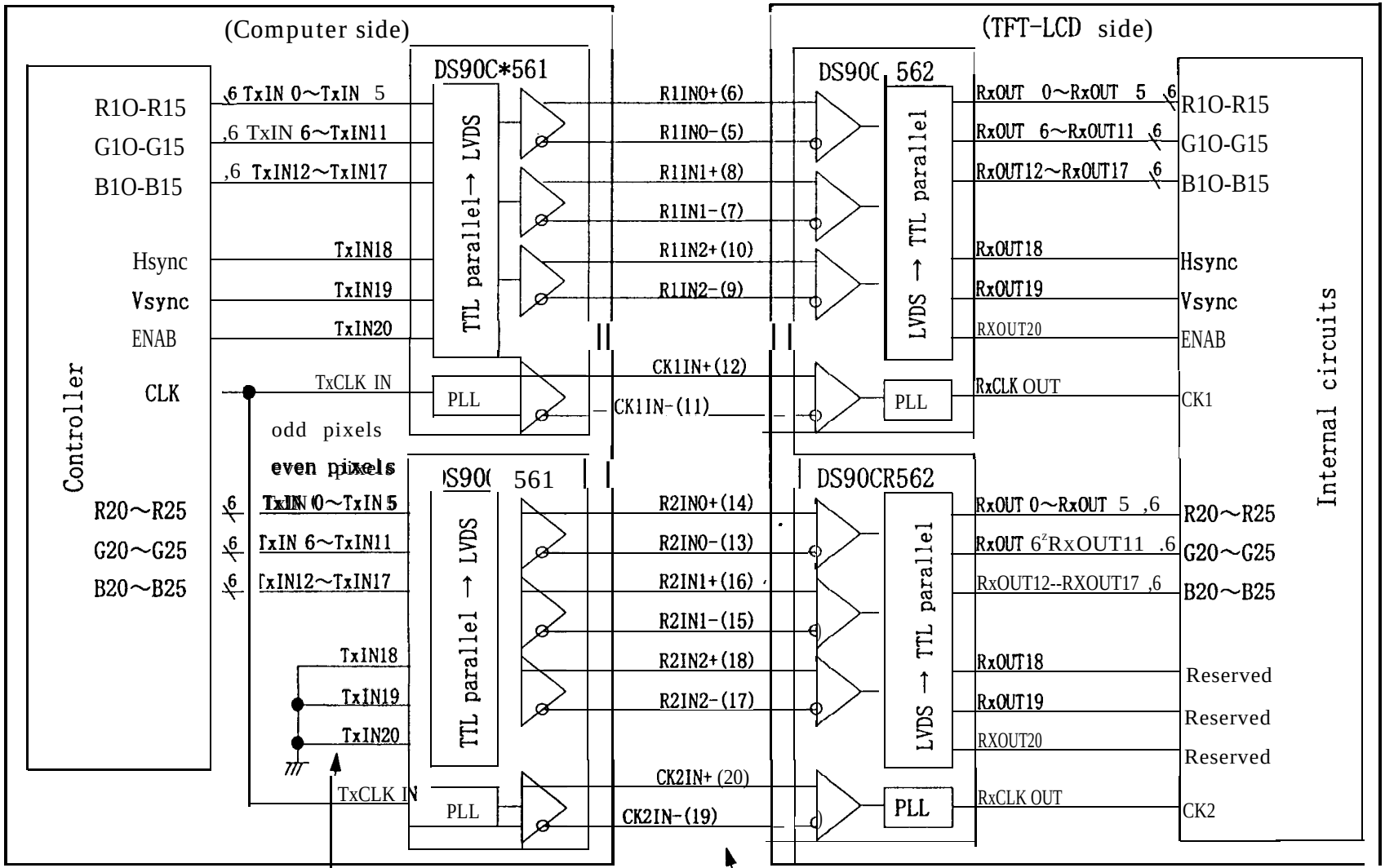
Pin No.	Symbol	Function	Remark
1	Vcc	+5V power supply	
2	Vcc	+5V power supply	
3	GND		
4	GND		
5	R1IN0-	Receiver signal of odd pixels (-)	LVDS
6	R1IN0+	Receiver signal of odd pixels (+)	LVDS
7	R1IN1-	Receiver signal of odd pixels (-)	LVDS
8	R1IN1+	Receiver signal of odd pixels (+)	LVDS
9	R1IN2-	Receiver signal of odd pixels (-)	LVDS
10	R1IN2+	Receiver signal of odd pixels (+)	LVDS
11	CK1IN-	Clock signal of odd pixels (-)	LVDS
12	CK1IN+	Clock signal of odd pixels (+)	LVDS
13	R2IN0-	Receiver signal of even pixels (-)	LVDS
14	R2IN0+	Receiver signal of even pixels (+)	LVDS
15	R2IN1-	Receiver signal of even pixels (-)	LVDS
16	R2IN1+	Receiver signal of even pixels (+)	LVDS
17	R2IN2-	Receiver signal of even pixels (-)	LVDS
18	R2IN2+	Receiver signal of even pixels (+)	LVDS
19	CK2IN-	Clock signal of even pixels (-)	LVDS
20	CK2IN+	Clock signal of even pixels (+)	LVDS

[Note 1] Relation between LVDS signals and actual data shows below section (4-2).

[Note 2] The shielding case is connected with signal GND.

4-2. Interface block **diagram**

Using receiver : **DS90CR562(National** semiconductor) **Corresponding Transmitter : DS90CR561,DS90CF561,DS90CR581,DS90CF581(National** semiconductor)



TxIN 18~20 must be fixed "Low".

Symbol of CN1 (Pin No.)

4-3. Backlight driving

CN2 : BHR-03VS-1(JST)

Mating connector: SM02(8.0)B-BHS(JST)

Pin no.	symbol	function
1	V_{HIGH}	Power supply for lamp (High voltage side)
2	NC	This is electrically opened.
3	V_{LOW}	Power supply for lamp (Low voltage side)

5. Absolute Maximum Ratings

Parameter	symbol	Condition	Ratings	unit	Remark
Input voltage	v,	Ta=25℃	–().3 ～Vcc+0.3	V	【Note1 I
+5.0V supply voltage	Vcc	Ta=25℃	0 ～ + 6	V	
Storage temperature	Tstg	-	–25 ～ +60	℃	【Note2】
Operating temperature (Ambient)	Topa	–	0 ～ +50	℃	

【Note1 1 LVDS signals

【Note2】Humidity : 95%RH Max. at Ta≦40℃.

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

No condensation.

6. Electrical Characteristics

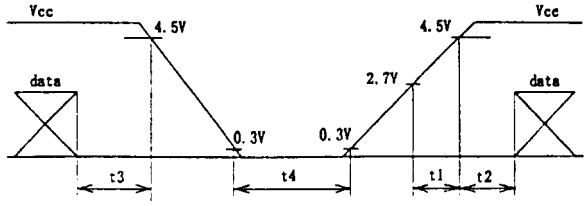
6-1. TFT-LCD panel driving

Ta＝25℃

Parameter			symbol	Min.	Typ.	Max.	unit	Remark
Vcc	Supply voltage		Vcc	+4.5	+5.0	+5.5	v	【Note2】
	Current dissipation		Icc	–	340	550	mA	【Note3】
Permissive input ripple voltage			V_{RP}	–	–	100	mVp-p	Vcc=+5.0V
Differential input threshold voltage		High	V_{TH}	‘	–	+100	mV	V_{CM}=+1.2V 【Note1】
		Low	V_{TL}	-1oo	-	–	mV	
Input current (High)			I_{OH}	-	-	±10	μA	V_I=2.4V Vcc=5.5V
Input current (Low)			I_{OL}	-	-	±10	μA	V_I=0V Vcc=5.5V
Terminal resistor			R_T	–	100	-	Ω	Differential input

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

【Note2】
On-off conditions for supply voltage



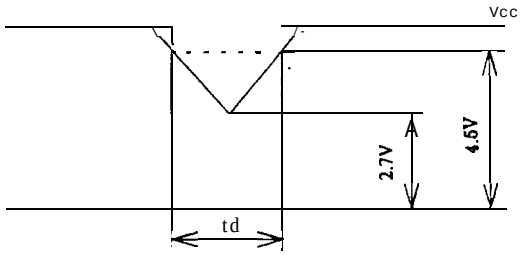
$0 < t1 \leqq 10ms$

$0 < t2 \leqq 10ms$

$0 < t3 \leqq 1s$

$t4 > 1s$

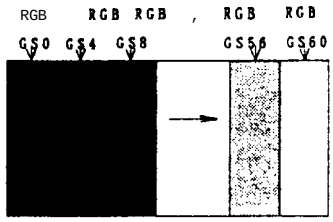
Vcc-dip conditions



1) $2.7V \leqq Vcc < 4.5V$
   $td \leqq 10ms$
2) $Vcc < 2.7V$

Vcc-dip conditions should also follow the on-off conditions

[Note31 Typical current situation : 16-gray-bar pattern.
(Vcc=+5.0V)

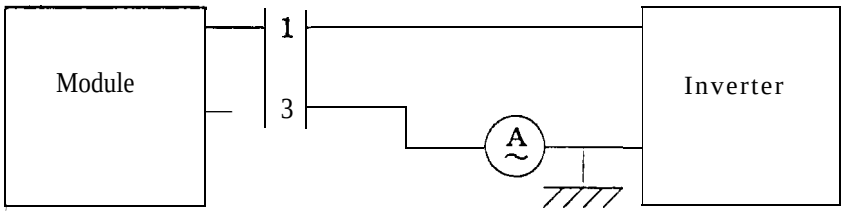


6-2. Backlight driving

The'backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube). The characteristics of the lamp are shown in the following table.

Parameter	symbol	Mill.	Typ.	Max.	unit	Remark
Lamp current range	IL	2.5	3.0	6.0	mArms	[Note 1]
Lamp voltage	V_L	–	630	–	Vrms	
Lamp power consumption	P_L	–	1.9	–	w	【Note2】
Lamp frequency	FL	20	35	60	KHz	【Note3】
Kick-off voltage	Vs	–	–	1300	Vrms	Ta=25℃
		–	–	1400	Vrms	Ta=0℃ 【Note4】
Lamp life time	LL	1000O	–	–	hour	【Note5】

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



* 3pin is V LOW

【Note2】 At the condition of Y_L =70cd/m^2

[Note3] Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached asmuch 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 startup. 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=6.0mArms.

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

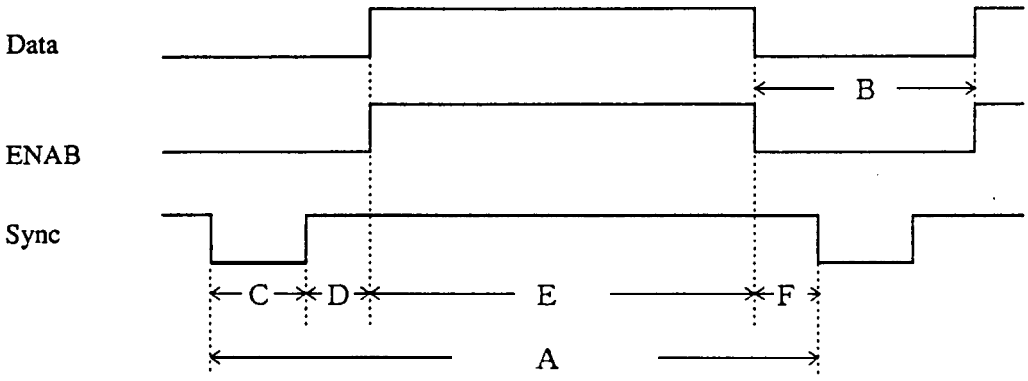
② Kick-off voltage at Ta=0℃ exceeds maximum value, 1400 Vrms.

Note) 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.

7. **Timing** characteristics of input signals

7-1. **Timing** characteristics

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



(vertical)

Item (symbol)	Min.	Typ.	Max.	unit	備考
Vsync cycle (TVA)	—	16.667	–	ms	Negative
	803	806	–	line"	
Blanking **period**(T_{VB})	35	38	–	line	
Sync pulse width (T_{VC})	4	6	—	line	
Back porch (T_{VD})	o	29		line	
Sync pulse **width+Back** porch ($T_{VC}+T_{VD}$)	35	35	35	line	
Active display area (T_{VE})	768	768	768	line	
Front porch (T_{VF})	o	3	—	line	

(Horizontal)

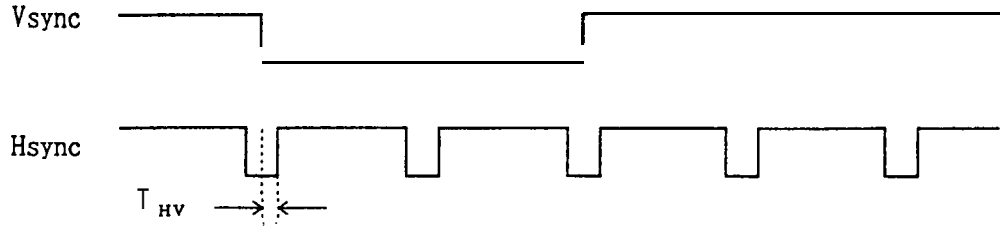
Item (symbol)	Min.	Typ.	Max.	unit	Remark
Hsync cycle (T_{HA})	19.2	20.677	–	μ s	Negative
	630	672	–	clock	
Blanking period (T_m)	118	160	–	clock	
Sync pulse width (T_{HC})	4	68	—	clock	
Back porch (T_{HD})	o	80	–	clock	
Active display area (T_m)	**512**	512	512	clock	
Front porch (T_m)	4	12	—	clock	

(Clock)

Item	Min.	Typ.	Max.	unit	Remark
Frequency	25.0	32.5	37.5	**MHz**	【Note1】

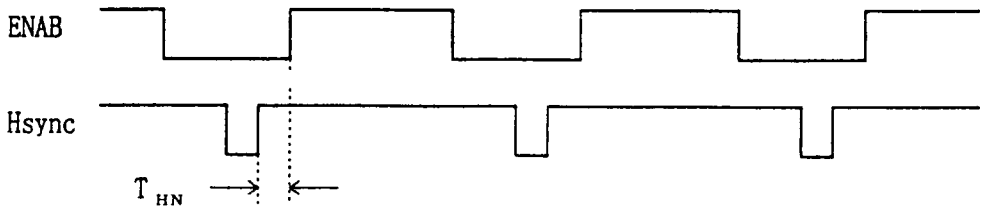
【Note1】 1 Two pixel-data are sampled at a time.

(Hsync-Vsync Phase difference)



Item(symbol)	Min.	Typ.	Max.	unit	Remark
Hsync-Vsync Phase difference(T_{HV})	1	–	$T_{HA}-T_{HC}$	clock	

(Hsync-ENAB Phase difference)



Item	Min.	Typ.	Max.	unit	Remark
(T_{HN})	o	–	156	clock	

7-2 Display position

Item	Standards	Beginning	Ending	unit	Remark
Horizontal	rising edge of ENAB	o	512	clock	
	falling edge of Hsync	148	660	clock	[Note 1]
Vertical	falling edge of Vsync	35	803	clock	

【Note1 1 ENAB signal must be freed to low.

Note)

(Horizontal display direction)

When ENAB is fixed low, 148 clock are counted from Hsync falling edge and data from after are available. If you need other timing, please use ENAB signal.

(Vertical display direction)

35 lines are counted from Vsync falling edge and data from next line are available.

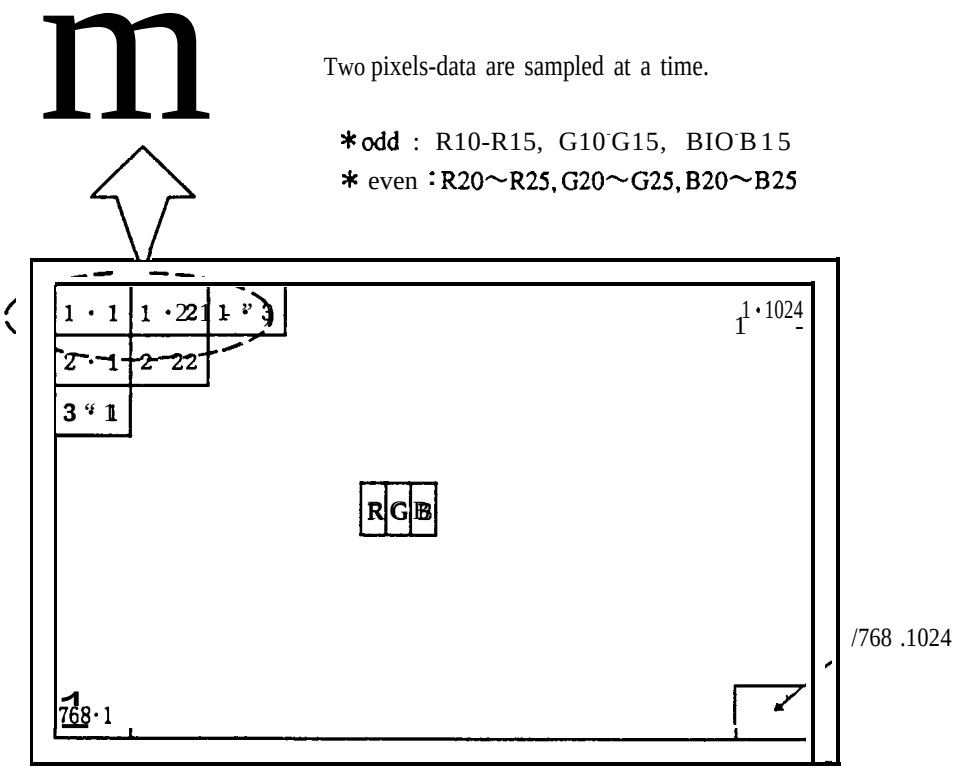
(Note of ENAB signal)

ENAB could not be used for the purpose of the vertical display start timing.

Caution

Image will not be displayed on the right position otherwise.

7-3 Input Data Signals and Display Position on the screen



Display position of input data (V • H)

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

	colors & Gray scale	GrayScale	D gnal R1O R11 R12 R13 R14 R15						G1O G11 G12 G13 G14 G15						B1O B11 B12 B13 B14 B15					
			R20	R21	R22	R23	R24	R25	G20	G21	G22	G23	G24	G25	B20	B21	B22	B23	B24	B25
Basic Color	Black	—	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	1	1	1	1	1	1
	Green	—	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	cyan	—	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	—	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	—	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	—	1	1	1	1	1	1	1	1	1	1	1	1	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
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓			↓						↓						↓			
	0	↓			↓						↓						↓			
	Brighter	GS61	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS62	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS63	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0
Gray Scale of Green	Black	GSO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	⇧	↓			↓						↓						↓			
	⇩	↓			↓						↓						↓			
	Brighter	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
	⇩	GS62	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	⇧	↓			↓						↓						↓			
	⇩	↓			↓						↓						↓			
	Brighter	GS61	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	⇩	GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

0 :Low level voltage, 1: High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

9. Optical **Characteristics**

Ta=25℃, Vcc=+3.3V

Parameter		symbol	Condition	Min.	Typ.	Max.	unit	Remark
Viewing angle range	Horizontal	021,622	CR>1O	45	-	-	Deg.	【Note1,4】
	Vertical	θ 11		10	-	-	Deg.	
		θ 12		30	-	-	Deg.	
Contrast ratio		CRn	θ=0°	150	–	–		【Note2,4】
		CRO	optimum viewing angle	—	300	-		
Response time	Rise	τ r		—	30	-	m s	【Note3,4】
	Decay	τ d		—	50	-	m s	
Chromaticity of white		x		—	0.313	-		【Note4】
		Y		—	0.329	-		
Luminance of white 【Note4】		Y_{L1}		50	70	-	cd/㎡	I_L=3.0mArms
		Y_{L2}		80	100	-	cd/㎡	I_L=5.1mArms
White Uniformity		δ w		—	—	1.45		【Note5】

※**The** measurement shall be executed 30 minutes after fighting at rating. (typical condition: I_L=3.0mArms)

The optical characteristics **shall** be measured in a dark room or equivalent state with the method shown in Fig.2 below.

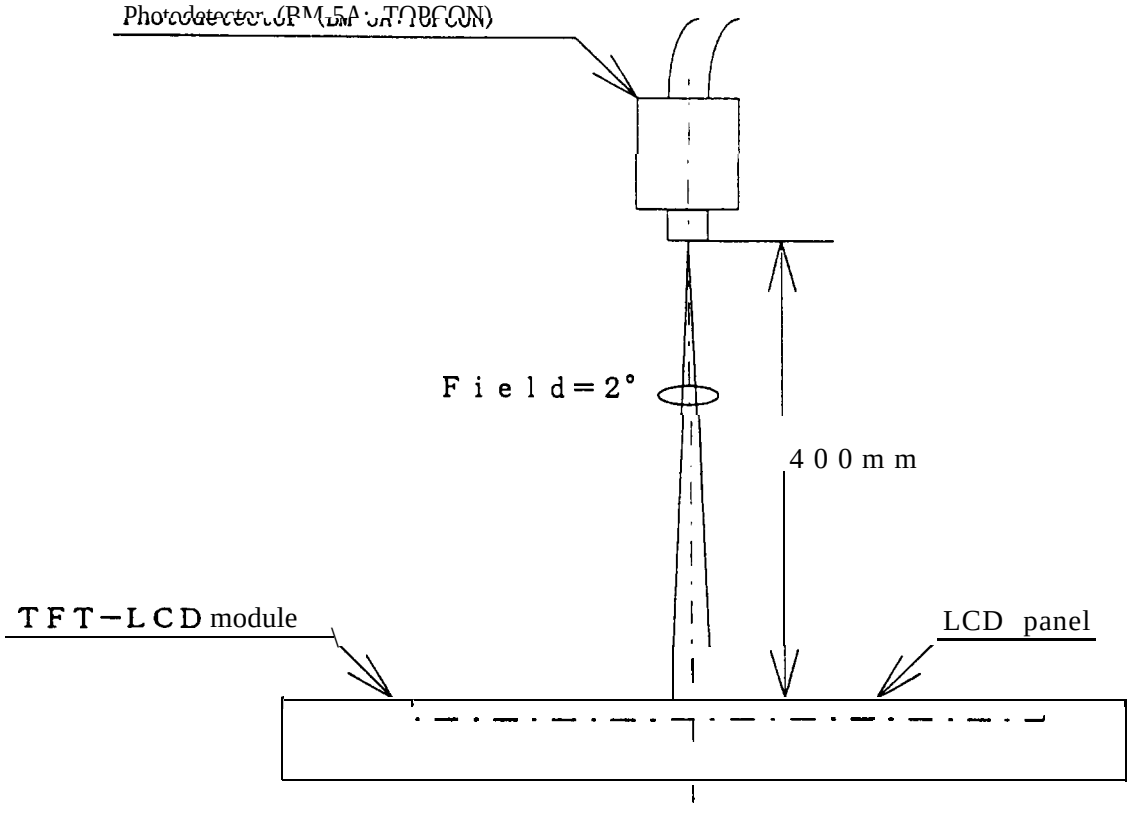
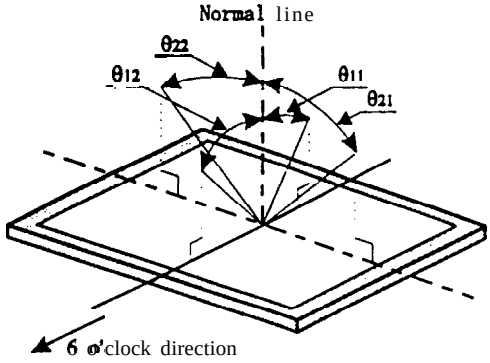


Fig. 2 Optical characteristics measurement method

【Note1】Definitions of viewing angle range:



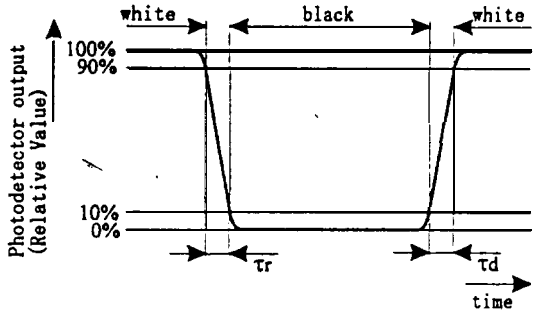
【Note2】Definition of contrast ratio:

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:

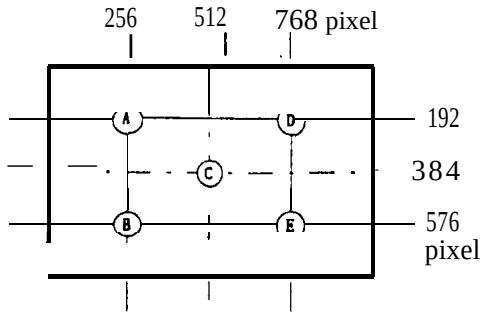
The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white” .



【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).



$$\delta w = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$

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. Packing form

a) Piling number of cartons : MAX. 7

b) Packing quantity in one carton :10 pcs

c) Carton size : 315(W) X 380(H) X 380(D) mm

d) Total mass of one carton filled with full modules : 7400g

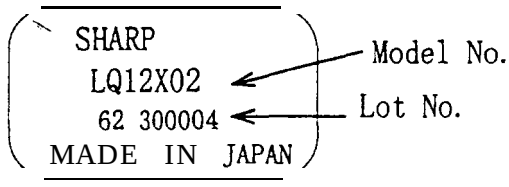
Packing form is shown in Fig.3.

13. Reliability test items

No.	Test item	Conditions
1	High temperature storage test	Ta=60℃ 240h
2	Low temperature storage test	Ta=-25℃ 240h
3	High temperature & high humidity operation test	Ta=40℃ ; 95%RH 240h (No condensation)
4	High temperature operation test	Ta=50℃ 240h (The panel temp. must be less than 60℃)
5	Low temperature operation test	Ta=0℃ 240H
6	Vibration test (non- operating)	Frequency: 10～57Hz/Vibration width (one side) :0.075mm : 58～500Hz/Gravity :9.8m/s2 Sweep time :11 minutes Test period :3 hours (1 hour for each direction of X,Y,Z)
7	Shock test (non- operating)	Max. gravity : 490m/s^2 Pulse width :11 ms, sine wave Direction : ±X,±Y,±Z once for each direction.

14. Others

1) Lot No. Label:

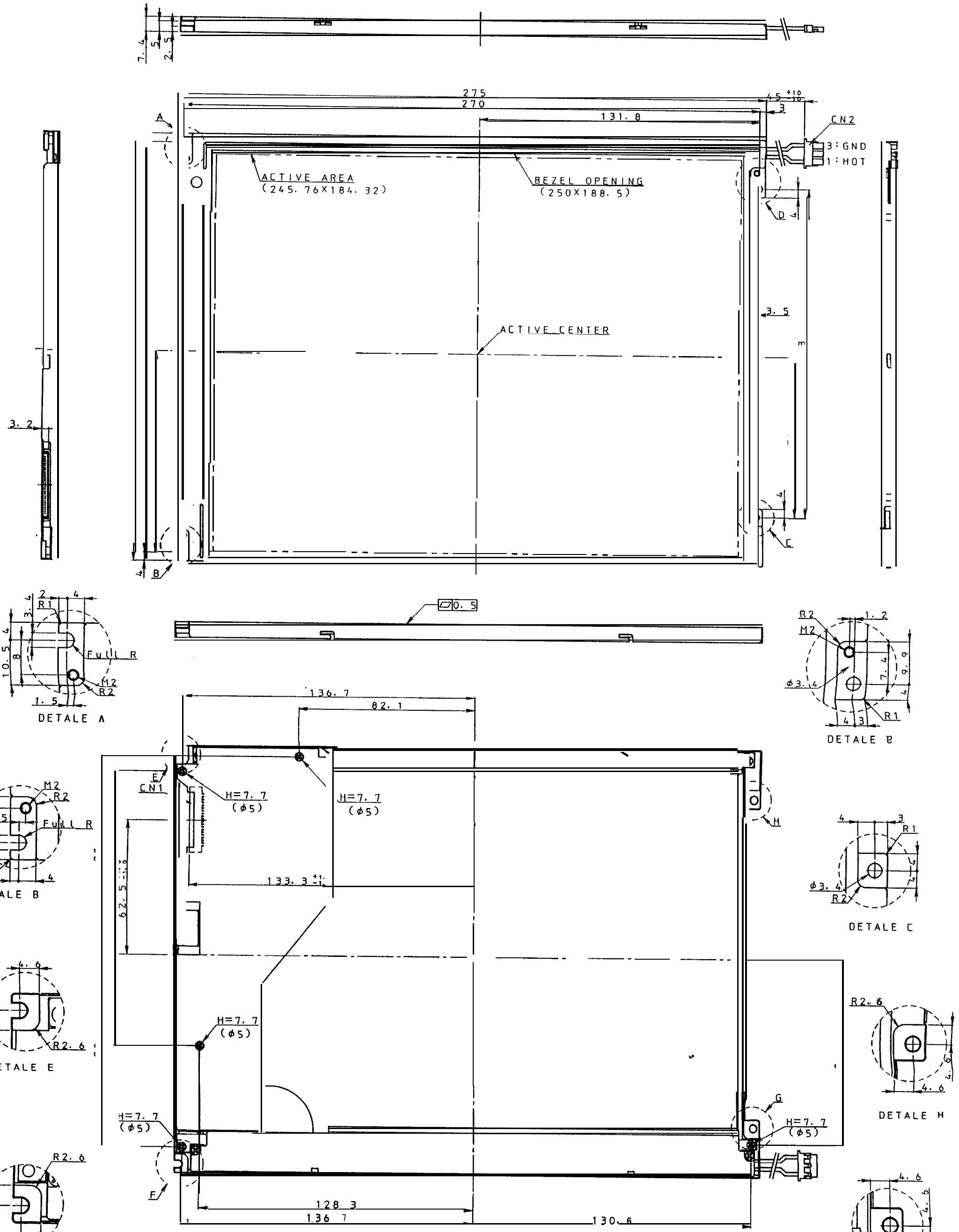


2) Adjusting volume have been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.

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.



NOTES: 1) UNSPECIFIED TOLERANCES TO BE ±0.5mm
2) WARP AND FLATING FOR BEZEL AND CHASSIS ARE EXCLUDED FROM THICKESS AND DIMENSION OF THE UNIT

CN1: INTERFACE CONNECTOR
DF-14A-20P-1.25H(HIROSE)

CN2: CCFT CONNECTOR
BHR-03VS-1(JST)

LD8333-16

Fig. 1 OUTLINE DIMENSIONS