PRODUCT SPECIFICATIONS

SHARP

AVC Liquid Crystal Displays Group

LQ230M1LW11

TFT-LCD Module

Spec. Issue Date: March 8, 2006

No: LD-18280

SHARP

No.	LD-18280
DATE	2006.03.08

TECHNICAL LITERATURE

FOR

TFT - LCD module

MODEL No. LQ230M1LW11

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RECORDS OF REVISION

LQ230M1LW11

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
LD-18280	Mar.08.2006	-	-	-	1 st Issue

1. Application

This technical literature applies to the color 23.0” WUXGA TFT-LCD module LQ230M1LW11.

* In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, and 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 technical literature.

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

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, power supply circuit, LED control circuit, LED back light system and etc. Graphics and texts can be displayed on a 1920×RGB×1200 dots panel with about 16 million colors by supplying data signal of 24 bit(8 bit x RGB) by using LVDS (Low Voltage Differential Signaling) and supplying +12V DC supply voltages for TFT-LCD panel driving and +24V DC and +5V DC supply voltage for LED back light.

And in order to improve the response time of LCD, this module applies the O/S (over shoot) driving technology for the control circuit .In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

By using the captioned process, the image signals of this LCD module are being set so that image response can be completed with in one frame, as a result, image blur can be improved and clear image performance can be realized.

By programming panel surface temperature into the module, this function enables to achieve high response time in every gray (color) scale.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	58 (Diagonal)	cm
	23.0 (Diagonal)	inch
Active area	495.36(H)×309.60 (V)	mm
Pixel Format	1920 (H) × 1200 (V) (pixel = R + G + B dot)	pixel
Pixel pitch	0.258 (H) ×0.258 (V)	mm
Pixel configuration	R, G, B vertical stripe	
Display mode	Normally black	
Unit Outline Dimensions *1	523.4(W)×335.6(H)×52.0(D)	mm
Mass	7400	g
Surface treatment	Anti Glare, Hard Coating :2H Haze Value :(48±8%) Low Reflection	

(*1)Outline dimensions are shown in Fig.1,2

4. Input Terminals

4-1. Control circuit driving

CN1 (Interface signals and +12V DC power supply ; Shown in Fig.1,2)

Using connector ：FI-X30SSL-HF (Japan Aviation Electronics Ind. , Ltd.) 【Note1】

Matching connector ：FI-X30H,FI-X30C or FI-X30M (Japan Aviation Electronics Ind. , Ltd.)

Matching LVDS transmitter ：DS90CF383 or C385 (National semiconductor) or equivalent.

Pin No.	Symbol	Function	I/O	Remark
1	RxO0-	Negative (-) LVDS CH0 differential data input (A port)	I	LVDS
2	RxO0+	Positive (+) LVDS CH0 differential data input (A port)	I	LVDS
3	RxO1-	Negative (-) LVDS CH1 differential data input (A port)	I	LVDS
4	RxO1+	Positive (+) LVDS CH1 differential data input (A port)	I	LVDS
5	RxO2-	Negative (-) LVDS CH2 differential data input (A port)	I	LVDS
6	RxO2+	Positive (+) LVDS CH2 differential data input (A port)	I	LVDS
7	GND	GND		
8	RxOC-	Negative (-) LVDS differential clock input (A port)	I	LVDS
9	RxOC+	Positive (+) LVDS differential clock input (A port)	I	LVDS
10	RxO3-	Negative (-) LVDS CH3 differential data input (A port)	I	LVDS
11	RxO3+	Positive (+) LVDS CH3 differential data input (A port)	I	LVDS
12	RxE0-	Negative (-) LVDS CH0 differential data input (B port)	I	LVDS
13	RxE0+	Positive (+) LVDS CH0 differential data input (B port)	I	LVDS
14	GND	GND		
15	RxE1-	Negative (-) LVDS CH1 differential data input (B port)	I	LVDS
16	RxE1+	Positive (+) LVDS CH1 differential data input (B port)	I	LVDS
17	GND	GND		
18	RxE2-	Negative (-) LVDS CH2 differential data input (B port)	I	LVDS
19	RxE2+	Positive (+) LVDS CH2 differential data input (B port)	I	LVDS
20	RxEC-	Negative (-) LVDS differential clock input (B port)	I	LVDS
21	RxEC+	Positive (+) LVDS differential clock input (B port)	I	LVDS
22	RxE3-	Negative (-) LVDS CH3 differential data input (B port)	I	LVDS
23	RxE3+	Positive (+) LVDS CH3 differential data input (B port)	I	LVDS
24	GND	GND		
25	SELLVDS	Select LVDS data order【Note1】	I	
26	N.C	【Note2】	I	
27	HRC OFF	O/ S function control 【Note3】	I	
28	V_{CC1}	+12V power supply		
29	V_{CC1}	+12V power supply		
30	V_{CC1}	+12V power supply		

※ Shield case on the back surface of module contacts to GND of internal circuit.

【Note1】3.3V CMOS Signal input.(High or Low)

【Note2】 Not Connected.

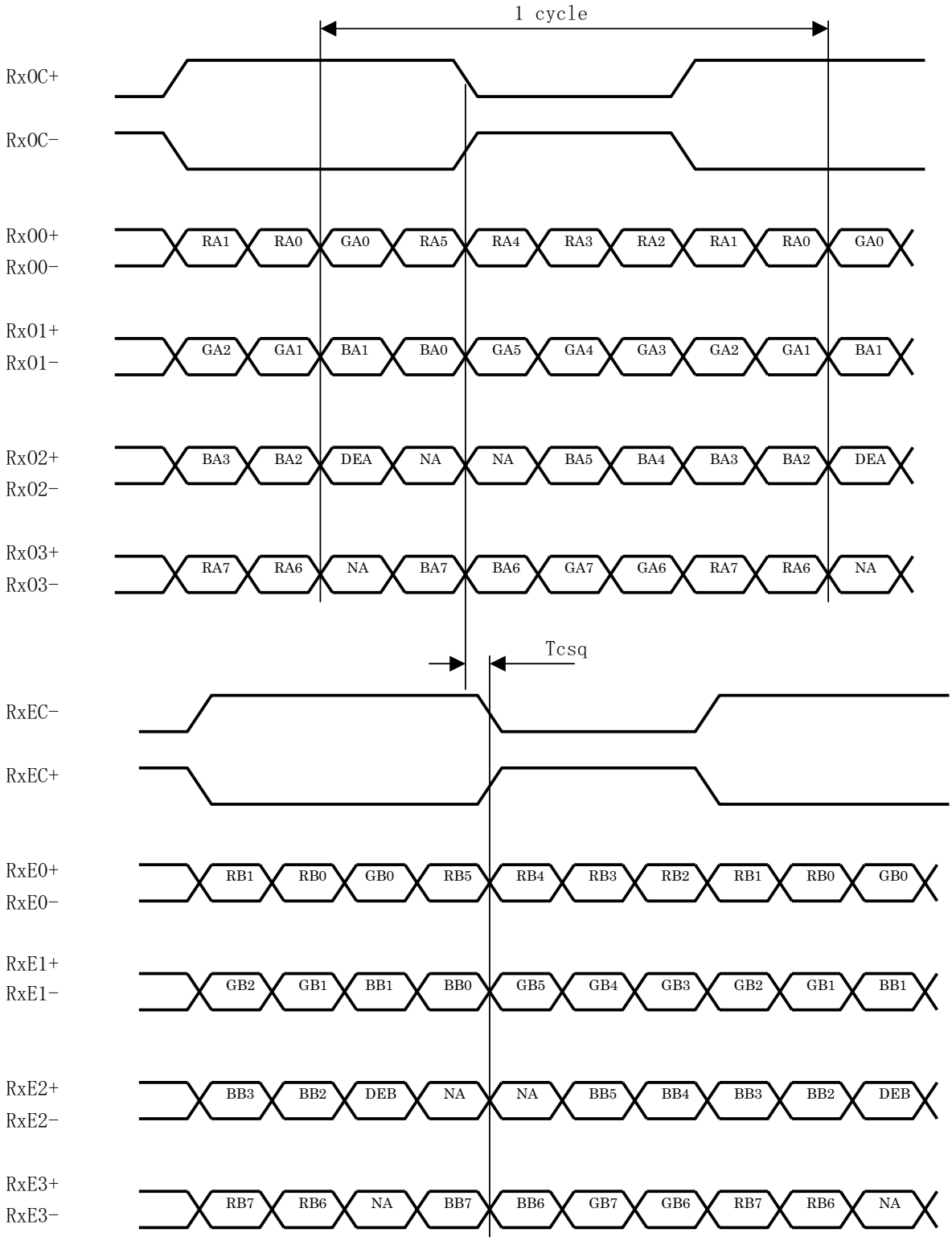
【Note3】 The O/S function is On at “L” (GND) and OFF at “H” (+3.3V).

4-2 Data Mapping

【Note1】pin assignment with LVDS_SET pin DS90CF383 or C385 (National semiconductor)

	Transmitter(DS90CF383,C385)		SELLVDS	
	Pin No	Data	=H(3.3V)	=L(GND) or Open
PORT A	51	TxIN0	RA0(LSB)	RA2
	52	TxIN1	RA1	RA3
	54	TxIN2	RA2	RA4
	55	TxIN3	RA3	RA5
	56	TxIN4	RA4	RA6
	3	TxIN6	RA5	RA7(MSB)
	4	TxIN7	GA0(LSB)	GA2
	6	TxIN8	GA1	GA3
	7	TxIN9	GA2	GA4
	11	TxIN12	GA3	GA5
	12	TxIN13	GA4	GA6
	14	TxIN14	GA5	GA7(MSB)
	15	TxIN15	BA0(LSB)	BA2
	19	TxIN18	BA1	BA3
	20	TxIN19	BA2	BA4
	22	TxIN20	BA3	BA5
	23	TxIN21	BA4	BA6
	24	TxIN22	BA5	BA7(MSB)
	27	TxIN24	NC	NC
	28	TxIN25	(RSV1)	(RSV1)
	30	TxIN26	DE	DE
	50	TxIN27	RA6	RA0(LSB)
	2	TxIN5	RA7(MSB)	RA1
	8	TxIN10	GA6	GA0(LSB)
	10	TxIN11	GA7(MSB)	GA1
	16	TxIN16	BA6	BA0(LSB)
	18	TxIN17	BA7(MSB)	BA1
	25	TxIN23	(NA)	(NA)
PORT B	51	TxIN0	RB0(LSB)	RB2
	52	TxIN1	RB1	RB3
	54	TxIN2	RB2	RB4
	55	TxIN3	RB3	RB5
	56	TxIN4	RB4	RB6
	3	TxIN6	RB5	RB7(MSB)
	4	TxIN7	GB0(LSB)	GB2
	6	TxIN8	GB1	GB3
	7	TxIN9	GB2	GB4
	11	TxIN12	GB3	GB5
	12	TxIN13	GB4	GB6
	14	TxIN14	GB5	GB7(MSB)
	15	TxIN15	BB0(LSB)	BB2
	19	TxIN18	BB1	BB3
	20	TxIN19	BB2	BB4
	22	TxIN20	BB3	BB5
	23	TxIN21	BB4	BB6
	24	TxIN22	BB5	BB7(MSB)
	27	TxIN24	NC	NC
	28	TxIN25	(RSV1)	(RSV1)
	30	TxIN26	DE	DE
	50	TxIN27	RB6	RB0(LSB)
	2	TxIN5	RB7(MSB)	RB1
	8	TxIN10	GB6	GB0(LSB)
	10	TxIN11	GB7(MSB)	GB1
	16	TxIN16	BB6	BB0(LSB)
	18	TxIN17	BB7(MSB)	BB1
	25	TxIN23	(NA)	(NA)

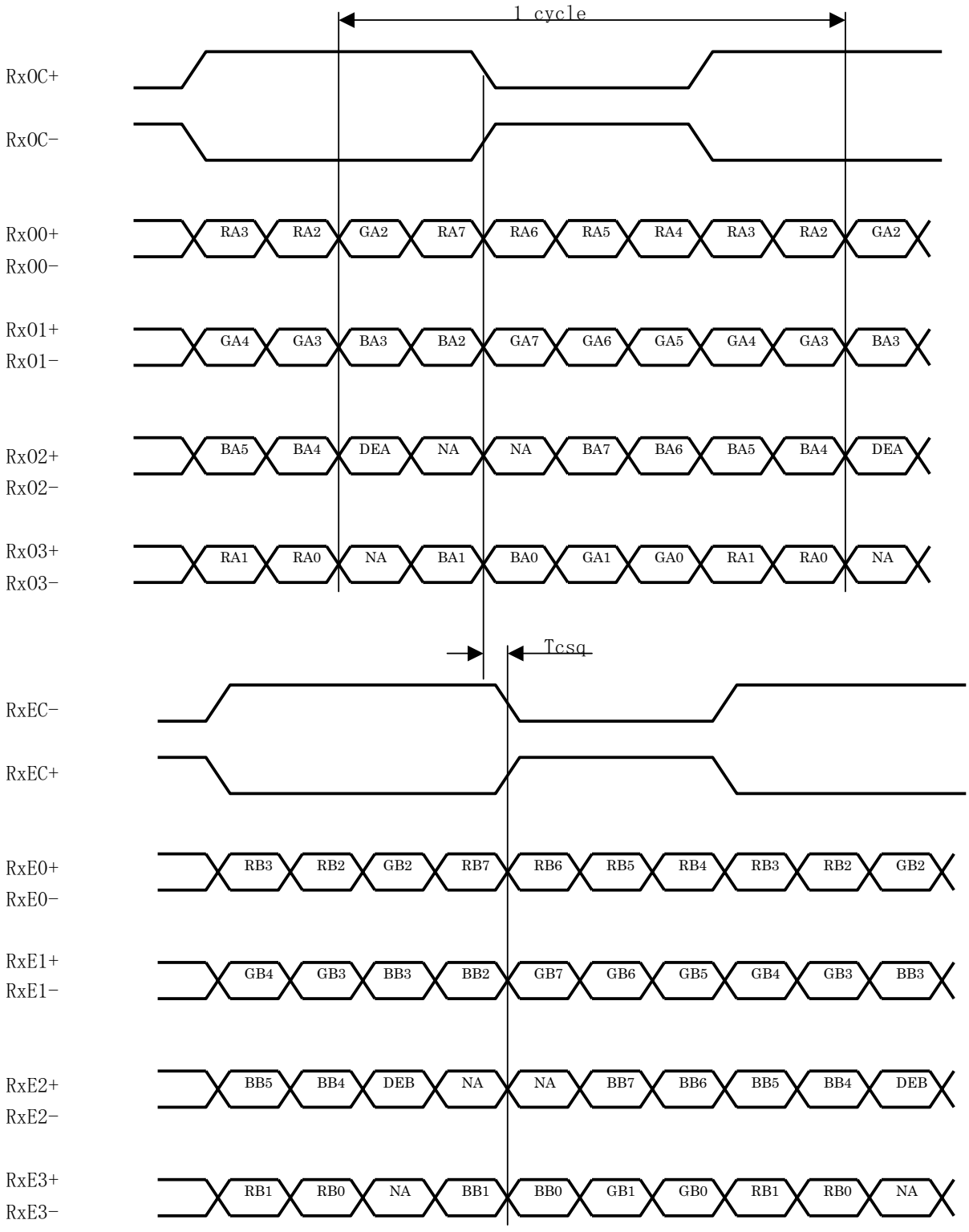
SELLVDS= High(3.3V)



DE: Display Enable

NA: Not Available

SELLVDS= Low(GND)



DE: Display Enable

NA: Not Availabl

4-3 Interface block diagram

Corresponding Transmitter: DS90CF383 or C385 (National semiconductor) or equivalent.

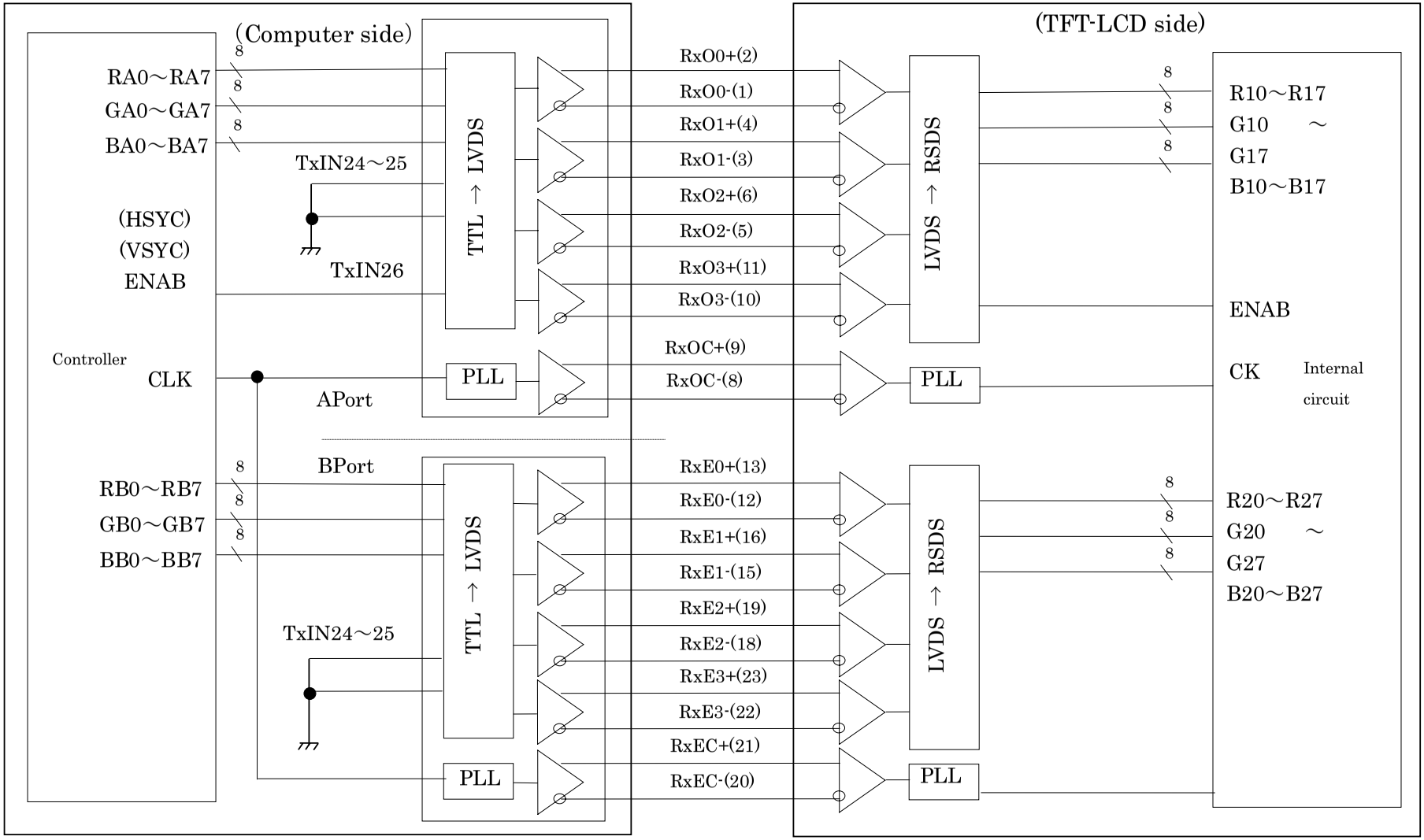


Fig.4-1. Interface Block Diagram

4-4. LED back light driving.

CN-1 Supplying for LED Power. (Shown in Fig.1,2)

Using connector ：S10B-PH-SM4-GW-TB(LF)(SN) (JST)

Matching connector：PHR-10（JST）

Pin No.	Signal	Function
1	V_{LED}	+24V DC power supply for LED driving.
2	V_{LED}	
3	V_{LED}	
4	V_{LED}	
5	GND	GND
6	GND	
7	GND	
8	GND	
9	GND	
10	V_{cc2}	+5V DC power supply for logic.

CN-2 Backlight control (Shown in Fig. 1,2)

Using connector : IL-Z-8PL-SMTYE (JAE)

Matching connector: IL-Z-8S-S125C3（JAE）

Pin No.	Signal	Function
1	SDA	I^2C Data
2	GND	GND
3	SCL	I^2C Clock
4	GND	GND
5	XRST	Reset * 1
6	WP	Should be open
7	ERR_FLAG	Error flag *2
8	GND	GND

*1 Output of reset IC.

*2 When any output to LED modules is open or LED don't turn on, error flag becomes high(+5V).
Please ignore ERR_FRAG signal when start up and LED turns off.

4-5. LED Back light

The LED back light system is side-lighting type.

The characteristics of the LED are shown in the following table. The value mentioned below is at the case of LCD module.

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Life time	T_L	-	60,000	-	Hour	【Note 1】

【Note 1】The life of the back-light is a 60,000 hours(Typ.) at the following conditions.

(1) Working condition.

(I) Ambient temperature: 25℃

(II) Brightness control: MAX

(2) Definition of life

(I) Brightness becomes 50% or less than the minimum brightness value shown in Table 9-1.

(II) Δx or Δy (color shift or display area shown in Tabale 9-1) becomes Δx>0.02 or Δy>0.02.

(III) The LED no longer lights.

4-6 LCD Module Block Diagram

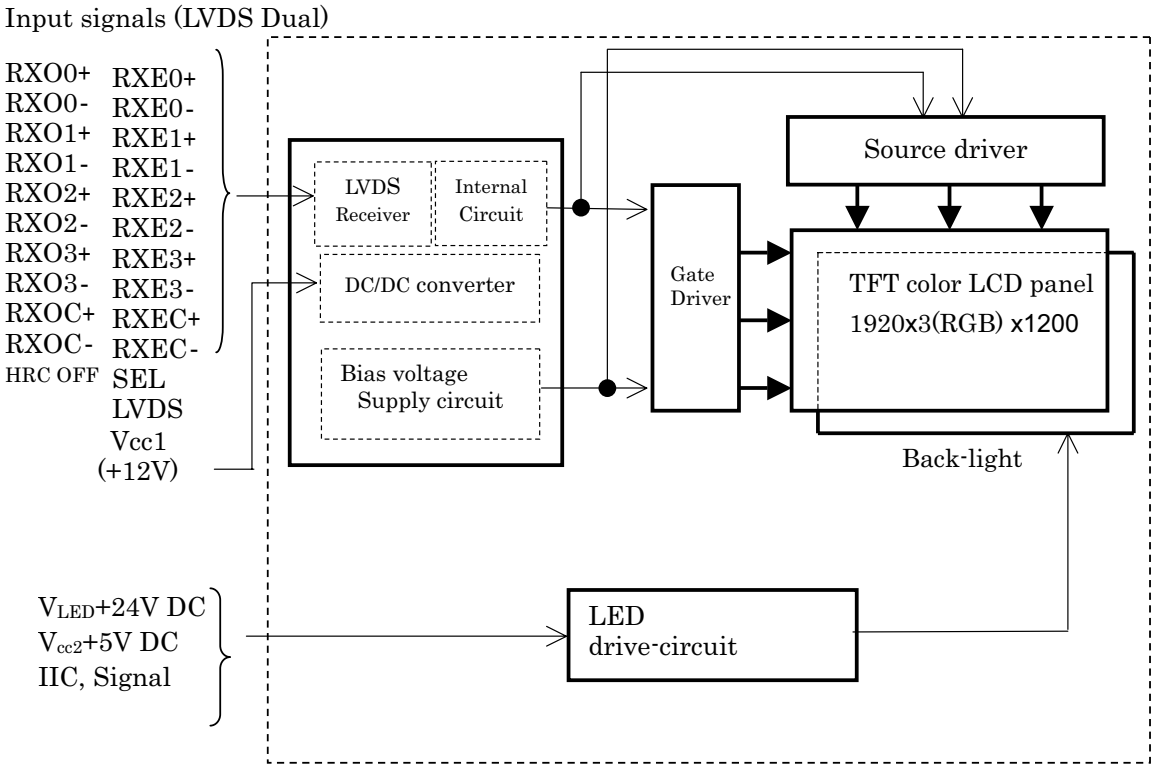


Fig.4-2. Block Diagram

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings			Unit	Remark
Supply voltage (for Control)	V_{CC1}	Ta=25℃	-0.3	～	+14.0	V	
Input signal voltage (LVDS signal, SELLVDS, HRC OFF)	V_{IN1}	Ta=25℃	-0.3	～	+3.6	V	【Note1】
Supply voltage (for LED)	V_{CC2}	Ta=25℃	-0.3	～	+6.0	V	
	V_{LED}	Ta=25 ℃	-0.3	～	+28	V	
Input signal voltage (LED Control:SDA,SCL)	V_{IN2}	Ta=25 ℃	-0.3	～	V_{CC2}+0.3	V	
Storage temperature	T_{stg}	—	-20	～	+60	℃	【Note2】
Operation temperature (Ambient)	T_{opa}	—	0	～	(+40)	℃	

【Note 1】 SELLVDS, HRC_OFF

【Note 2】 Humidity 95%RH Max.(Ta≦40 degree)

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

No condensation.

6. Electrical Characteristics

6-1. TFT-LCD panel driving　　Ta＝25℃

Parameter		Symbol	Min.	Typ.	Max.	Uniit	Remark
+12V supply Voltage	Supply voltage	Vcc1	+11.4	+12.0	+12.6	V	【Note1】
	Current dissipation	Icc1	—	(900)	(1200)	mA	【Note2】
	Rush current	Iscc1	—	—	(4.0)	A	【Note3】
	Rush current duration	Tscc	—	—	(5.0)	mS	
Ripple Voltage		V_{RP1}	—	—	100	mV p-p	Vcc1=+12.0V
Differential input threshold voltage(High)		V_{TH}	—	—	+100	mV	V_{CM}=+1.2V 【Note4】
Differential input threshold voltage(Low)		V_{TL}	-100	—	—	mV	
Input signal voltage		V_{IN1}	-0.3	-	3.6	V	【Note5】

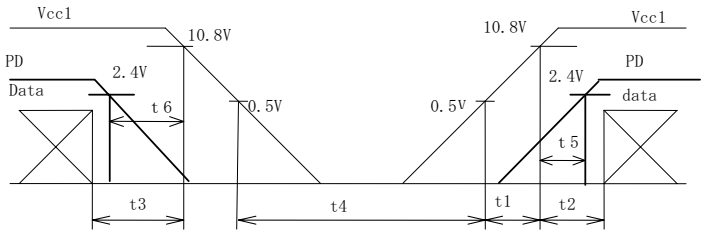
【Note 1】

1) Input voltage sequences

0.1ms≦t1 ≦20ms, 1ms≦t2≦40ms

0ms≦t3≦40ms,　t4≧0.5s

t5≧0ms,　0ms≦t6≦40ms,



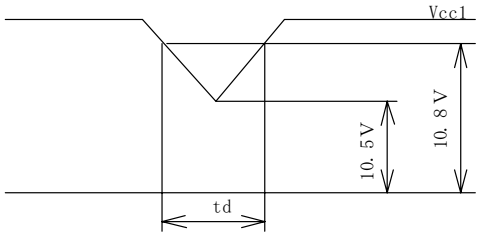
2) Dip conditions for supply voltage

a) 10.5V ≦ Vcc < 10.8V

td ≦ 20ms

b) Vcc < 10.5V

Condition of Dip conditions for supply voltage is based on input voltage sequence.



【Note 2】Typical current situation : Vertical Gray Scale(Vcc=+12.0V)　(Fig.6.1)

The explanation of RGB gray scale see section 8.

Maximum Current situation:　(1pixel checker pattern Vcc=+11.4V)

Fig.6.1 (Vertical Gray Pattern)

【Note 3】 These items prescribe the rush current for starting internal DC/DC.

Charging current to capacitors of Vcc is not prescribed.

【Note 4】 V_{CM} : Common mode voltage of LVDS driver.

【Note 5】 SELLVDS, HRC_OFF

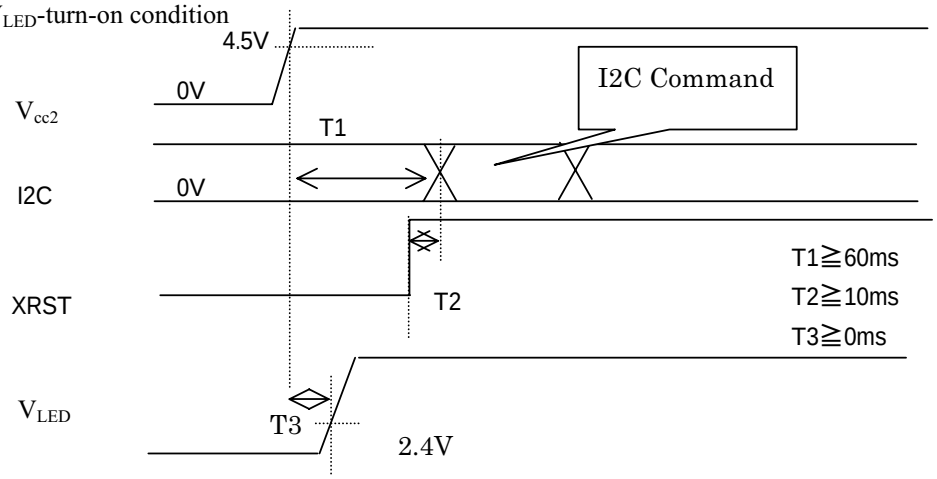
6-2. LED driving for back light

The back light system is side-lighting type with 102 LEDs .

Ta=25℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
＋24V (for LED drive)	Supply Voltage	V_{LED}	22.8	24.0	25.2	V	【Note 1】
	Current dissipation	I_{LED}	-	(3.1)	(3.44)	A	V_{LED}=+24V
	Rush current	I_{SCC2}			(6)	A	
+5V (for LED control)	Supply voltage (OFF)	V_{cc2}	4.75	5	5.25	V	【Note 1,2】
	Current dissipation	I_{cc2}	-	-	0.5	A	
	Permissive input ripple voltage	V_{RP2}	-	-	TBD	mV_{P-P}	
Input signal voltage(High)		Vin2H	0.7×V_{cc2}	-	V_{cc2}	V	【Note 2】
Input signal voltage(Low)		Vin2L	0	-	0.3×V_{cc2}	V	

【Note 1】1)V_{CC2} V_{LED}-turn-on condition



【Note 2】SDA,SCL

7. Timing characteristics of input signals

7-1. Timing characteristics

Timing diagrams of input signal are shown in Fig.7.1

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	(50)	81	(85)	MHz	
	Skew	T_{csq}	(T.B.D)	0	(T.B.D)	ns	【Note1】
Data enable signal	Horizontal period	TH	(1020)	1080	(1130)	clock	
			(13.0)	13.3	(14.65)	μs	
	Horizontal period (High)	THd	960	960	960	clock	【Note2】
	Vertical period	TV	1207	1250	1280	line	【Note3,4,5】
			(16.2)	16.6	(20.8)	mS	
			(48)	60	(61)	Hz	
	Vertical period (High)	TVd	1200	1200	1200	line	【Note5】

【Note1】 LVDS(A port data)-LVDS(B port data) phase difference.

【Note2】 If the “High” level period of DE is less than 960 clock, black color is displayed at the rest of the display area.

【Note3】 When vertical period is very long, flicker and etc. may occur.

【Note4】 If vertical DE blank time is less than 5500 clock, LCD unit may stop display.
Please keep DE blank at anytime.(ex. Change display mode.)

【Note5】 It is recommend making sure that length of vertical period is an integral multiple of horizontal length of period and vertical period is same length of period in each flame. Otherwise, the screen may not display properly. If it is difficult to control vertical period, **please ask us.**

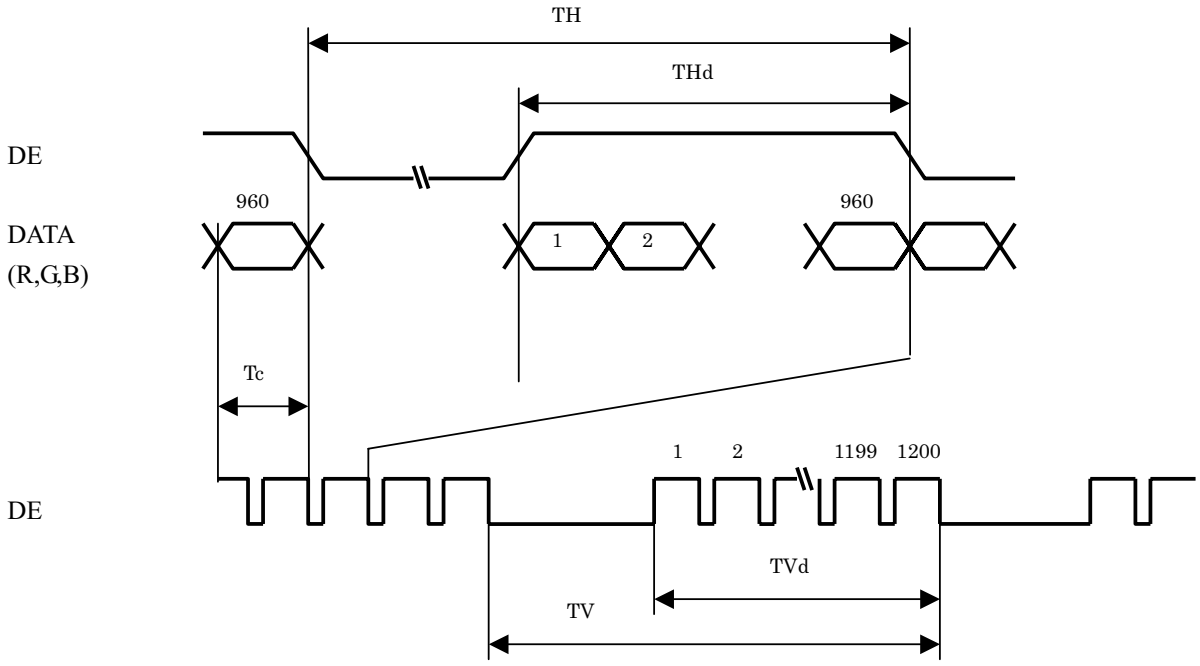
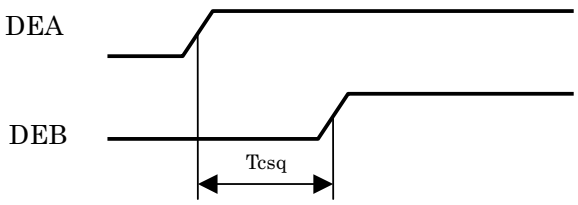
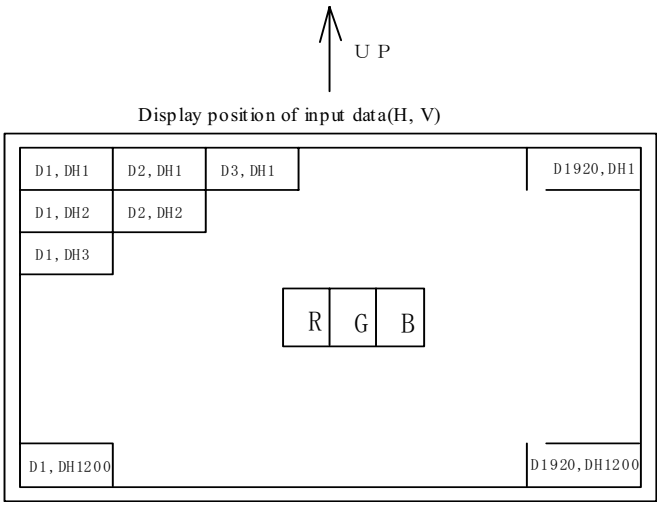


fig. 7.1



7-2. Input data signal and display position on the screen



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

	Color & Gray scale	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
	Magent	－	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	GS0	0	0	0	0	0	0	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	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	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS254	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	GS255	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	GS0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	GS254	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	GS255	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	GS0	0	0	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧	↓					↓								↓								↓			
	⇩	↓					↓								↓								↓			
	Brighter	GS253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	GS254	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	GS255	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 with 8 bit data signals. According to the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

9. Optical characteristics

Ta=25℃, Vcc=+5.0V , V_{INV}=＋12.0V, Brightness=MAX

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ21, θ22	CR≧10	-	(89)	-	Deg.	【Note1,4】
	Vertical	θ11 θ12		-	(89)	-	Deg.	
Color Shift	Horizontal	θ⊿u'v' ▪21 θ⊿u'v' ▪22	θ⊿u'v'≦0.04		(89)			【Note1,4,6】
	Vertical	θ⊿u'v' ▪11 θ⊿u'v' ▪12	θ⊿u'v'≦0.04		(89)			
Contrast ratio		CRn	Best Viewing Angle	(350)	(600)	-		【Note2,4】
Response time (Black → White → Black)		τr+τd	θ=0° Ta=25℃	—	(2)	—	ms	【Note3,4】
Response time(ON or OFF) (All gray scale)		Tavg	θ11,12,21,22 =0°	—	(8)		ms	Average of Response Time
Chromaticity of white		X	Vcc=12.0V V_{LED}=24.0V (At maximum brightness) R,G,B signal=All"H" Under color set point (x,y)=(0.313,0.329)	0.298	0.313	0.328	-	【Note 4】
		Y		0.299	0.329	0.359	-	
Chromaticity of Red		X		T.B.D	(0.692)	T.B.D	-	
		Y		T.B.D	(0.303)	T.B.D	-	
Chromaticity of Green		X		T.B.D	(0.205)	T.B.D	-	
		Y		T.B.D	(0.694)	T.B.D	-	
Chromaticity of Blue		X		T.B.D	(0.146)	T.B.D	-	
		Y		T.B.D	(0.086)	T.B.D	-	
Luminance of white		YL1		(62)	(180)	(TBD)	cd/m^2	【Note 4】
Luminance uniformity		δW		-	(1.17)	1.34		【Note 5】
Gray scale			(sRGB), ⊿u'v'gray≦ (0.02)					【Note 7】

*The measurement shall be executed 30 minutes after lighting at rating.

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3 below.

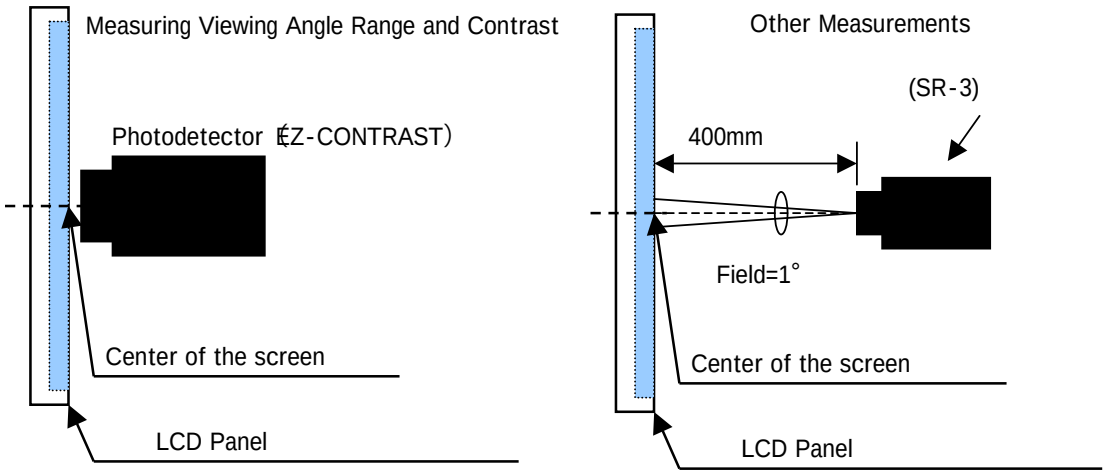
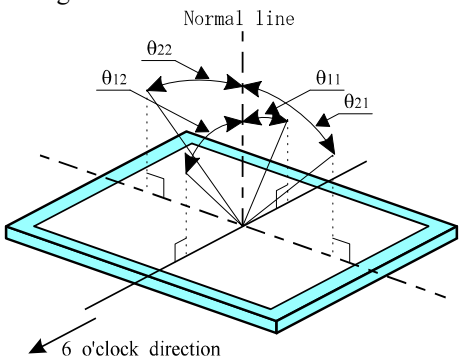


Fig.9-1 Optical characteristics measurement method

【Note 1】Definitions of viewing angle range :



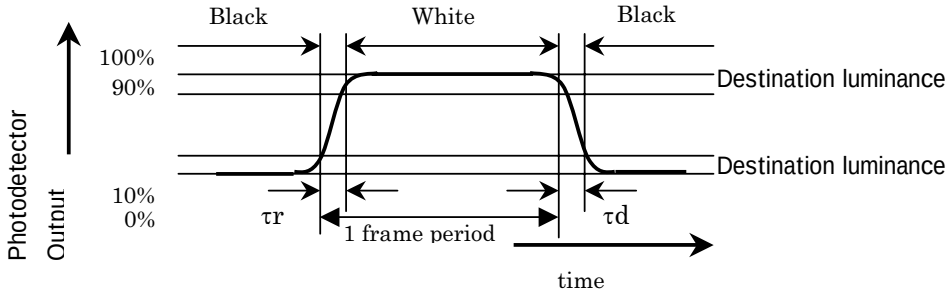
【Note 2】Definition of contrast ratio :

The contrast ratio is defined as the following.

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

【Note 3】Definition of response time

The response time is defined as the following figure.

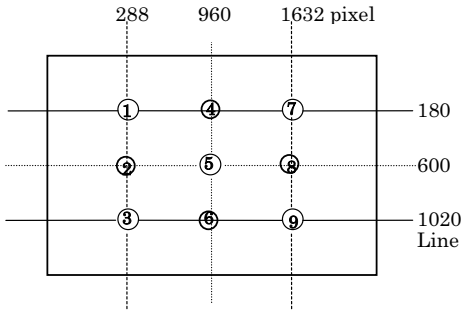


【Note 4】This shall be measured at center of the screen.

【Note 5】Definition of white uniformity ;

White uniformity is defined as the following with nine measurements.(①～⑨)

$$\delta W = \frac{\text{maximum Luminance of nine points(brightness)}}{\text{minimum Luminace of nine points(brightness)}}$$



【Note 6】$\theta_{\Delta u'v'}$ is the angle that the average of $\Delta_{u'v'}n$ value in 32 colors is lower than 0.04. $\Delta_{u'v'}n$ of each amgles means color difference compared with front direction.

$$\Delta u'v'n = \sqrt{(u'_{n1} - u'_{n2})^2 + (v'_{n1} - v'_{n2})^2}$$

$$u' = \frac{4x}{-2x + 12y + 3}, v' = \frac{9y}{-2x + 12y + 3}$$

u'_{n1}, v'_{n1} : $u'v'$ *value at viewing angle direction.*

u'_{n2}, v'_{n2} : $u'v'$ *value at front direction.*

n : *Color Number* 1～32 (*Table*9－2)

	1 dark skin	2 light skin	3 blue sky	4 foliage	5 blue flower	6 bluish green
R	98	206	85	77	129	114
G	56	142	112	102	118	199
B	45	123	161	46	183	178
	7 orange	8 purplish blue	9 moderate red	10 purple	11 yellow green	12 orange yellow
R	219	56	211	76	160	230
G	104	69	67	39	193	162
B	24	174	87	86	58	29
	13 blue	14 green	15 red	16 yellow	17 magenta	18 cyan
R	26	72	197	241	207	35
G	32	148	27	212	62	126
B	145	65	37	36	151	172
	19 white	20 neutral 8	21 neutral 6.5	22 neutral 5	23 neutral 3.5	24 black
R	240	206	155	110	63	22
G	240	206	155	110	63	22
B	240	206	155	110	63	22

	25 full white	26 full black	27 full red	28 full green	29 full blue	30 full yellow
R	255	0	255	0	0	255
G	255	0	0	255	0	255
B	255	0	0	0	255	0
	31 full magenta	32 full cyan				
R	255	0				
G	0	255				
B	255	255				

1～24:GretagMacbeth Charats,25～32:elementary colors

Tabale 9-2: RGB value of color number 1-32

【Note 7】 Specification of gray scale

$$\Delta u'v'gray = \sqrt{(u'_{255} - u'_n)^2 + (v'_{255} - v'_n)^2}$$

n : 31,63,95,127,159,191,223

Gray level n	Relative luminance (%)
0	(0.2)
31	(1.4)
63	(4.8)
95	(11.1)
127	(20.6)
159	(33.6)
191	(50.9)
223	(73.1)
255	100

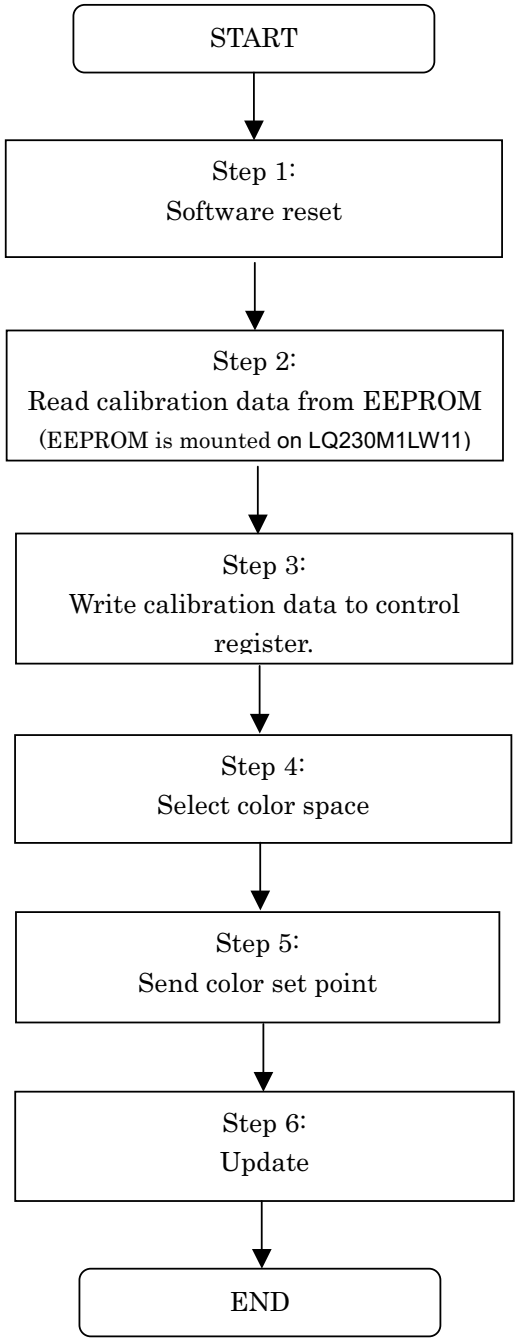
Table 9-3: Specification of gray scale

10. The method of control brightness and color temperature.

By using IIC-bus (CN-2), the brightness and the color temperature are able to control.

10-1 Normal operating mode

10-1-1 Normal operating procedure flow chart.



10-1-2 Normal operating steps.

Step 1 ~ 2

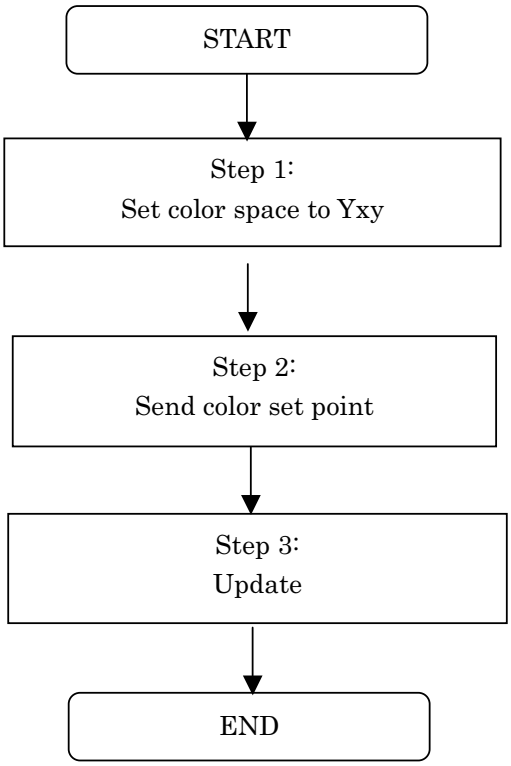
Program		
Step	IIC Data Sequence	Comments
1.1	S[0xA8][0x01][0x01]P	Software reset.
1.2	S[0xA8][0x09]S[0xA9][*ST*]P	Check *ST* = 0x02 to ensure reset is completed.
2.1	S[0xA0][0x00]S[0xA1][C0]P	
2.2	S[0xA0][0x01]S[0xA1][C1]P	
2.3	S[0xA0][0x02]S[0xA1][C2]P	
2.4	S[0xA0][0x03]S[0xA1][C3]P	
2.5	S[0xA0][0x04]S[0xA1][C4]P	
2.6	S[0xA0][0x05]S[0xA1][C5]P	
2.7	S[0xA0][0x06]S[0xA1][C6]P	
2.8	S[0xA0][0x07]S[0xA1][C7]P	
2.9	S[0xA0][0x08]S[0xA1][C8]P	
2.10	S[0xA0][0x09]S[0xA1][C9]P	
2.11	S[0xA0][0x0A]S[0xA1][C10]P	
2.12	S[0xA0][0x0B]S[0xA1][C11]P	
2.13	S[0xA0][0x0C]S[0xA1][C12]P	
2.14	S[0xA0][0x0D]S[0xA1][C13]P	
2.15	S[0xA0][0x0E]S[0xA1][C14]P	
2.16	S[0xA0][0x0F]S[0xA1][C15]P	
2.17	S[0xA0][0x10]S[0xA1][C16]P	Read calibration data to IIC. (C0～C32)
2.18	S[0xA0][0x11]S[0xA1][C17]P	
2.19	S[0xA0][0x12]S[0xA1][C18]P	
2.20	S[0xA0][0x13]S[0xA1][C19]P	
2.21	S[0xA0][0x14]S[0xA1][C20]P	
2.22	S[0xA0][0x15]S[0xA1][C21]P	
2.23	S[0xA0][0x16]S[0xA1][C22]P	
2.24	S[0xA0][0x17]S[0xA1][C23]P	
2.25	S[0xA0][0x18]S[0xA1][C24]P	
2.26	S[0xA0][0x19]S[0xA1][C25]P	
2.27	S[0xA0][0x1A]S[0xA1][C26]P	
2.28	S[0xA0][0x1B]S[0xA1][C27]P	
2.29	S[0xA0][0x1C]S[0xA1][C28]P	
2.30	S[0xA0][0x1D]S[0xA1][C29]P	
2.31	S[0xA0][0x1E]S[0xA1][C30]P	
2.32	S[0xA0][0x1F]S[0xA1][C31]P	
2.33	S[0xA0][0x20]S[0xA1][C32]P	

Step 3 ~ 6

Program		
Step	**IIC Data Sequence**	**Comments**
3.1	S[0xA8][0x8A][*C0*]P	Write calibration data to HDSM-J822.
3.2	S[0xA8][0x8B][*C1]P*	
3.3	S[0xA8][0x8C][*C2]P*	
3.4	S[0xA8][0x8D][*C3]P*	
3.5	S[0xA8][0x8E][*C4]P*	
3.6	S[0xA8][0x8F][*C5]P*	
3.7	S[0xA8][0x90][*C6]P*	
3.8	S[0xA8][0x91][*C7]P*	
3.9	S[0xA8][0x92][*C8]P*	
3.10	S[0xA8][0x93][*C9]P*	
3.11	S[0xA8][0x94][*C10]P*	
3.12	S[0xA8][0x95][*C11]P*	
3.13	S[0xA8][0x96][*C12]P*	
3.14	S[0xA8][0x97][*C13]P*	
3.15	S[0xA8][0x98][*C14]P*	
3.16	S[0xA8][0x99][*C15]P*	
3.17	S[0xA8][0x9A][*C16]P*	
3.18	S[0xA8][0x9B][*C17]P*	
3.19	S[0xA8][0x9C][*C18]P*	
3.20	S[0xA8][0x9D][*C19]P*	
3.21	S[0xA8][0x9E][*C20]P*	
3.22	S[0xA8][0x9F][*C21]P*	
3.23	S[0xA8][0xA0][*C22]P*	
3.24	S[0xA8][0xA1][*C23]P*	
3.25	S[0xA8][0xA2][*C24]P*	
3.26	S[0xA8][0xA3][*C25]P*	
3.27	S[0xA8][0xA4][*C26]P*	
3.28	S[0xA8][0xA5][*C27]P*	
3.29	S[0xA8][0xA6][*C28]P*	
3.30	S[0xA8][0xA7][*C29]P*	
3.31	S[0xA8][0xA8][*C30]P*	
4.	S[0xA8][0x04][0x02]P	S[0xA8][0x04][*CS*]P Select Yxy color space .Write *CS* value to 0x02..
5.1	S[0xA8][0xEC][*C31*]P, S[0xA8][0xED][*C32*]P	S[0xA8][0xEC][*ALO*]P, S[0xA8][0xED][*AHI*]P Send Y value. *AHI:*Upper 2 bits of the Y value read from EEPROM. Write [*C32*] value. *ALO:* Lower 2 bits of the Y value read from EEPROM. Write [*C31*] value.
5.2	S[0xA8][0xEA][0x39]P, S[0xA8][0xEB][0x01]P	S[0xA8][0xEC][*BLO*]P, S[0xA8][0xED][*BHI*]P Send x value. *BHI:*Upper 2 bits of the x*1000 value. *BLO:*Lower 2 bits of the x*1000 value.
5.3	S[0xA8][0xE8][0x49]P, S[0xA8][0xE9][0x01]P	S[0xA8][0xEC][*CLO*]P, S[0xA8][0xED][*CHI*]P Send y value. *CHI:*Upper 2 bits of the y*1000 value. *CLO:*Lower 2 bits of the y*1000 value.
6.	S[0xA8][0x01][0x12]P	Update new color set point

10-2 Change white point

10-2-1 Change white point flow chart.

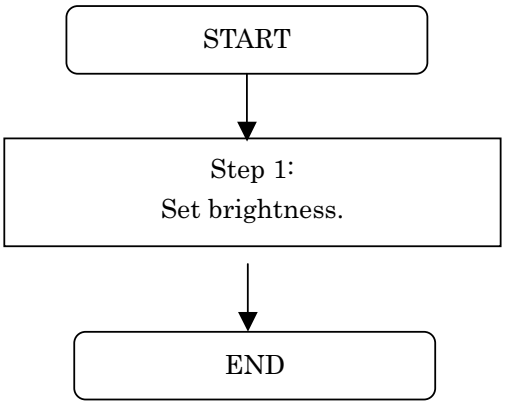


10-2-2 Change white point steps.

Program		
Step	IIC Data Sequence	Comments
1.	S[0xA8][0x04][0x02]P	S[0xA8][0x04][*CS*]P Select Yxy color space .Write *CS* value to 0x02.
2.1	S[0xA8][0xEA][0x39]P, S[0xA8][0xEB][0x01]P	S[0xA8][0xEC][*BLO*]P, S[0xA8][0xED][*BHI*]P Send x value. *BHI:*Upper 2 bits of the x*1000 value. *BLO:*Lower 2 bits of the x*1000 value.
2.2	S[0xA8][0xE8][0x49]P, S[0xA8][0xE9][0x01]P	S[0xA8][0xEC][*CLO*]P, S[0xA8][0xED][*CHI*]P Send y value. *CHI:*Upper 2 bits of the y*1000 value. *CLO:*Lower 2 bits of the y*1000 value.
3.	S[0xA8][0x01][0x12]P	Update new color set point

10-3 Change brightness

10-3-1 Change brightness flow chart.



10-3-1 Change brightness flow chart.

Program		
Step	IIC Data Sequence	Comments
1.	S[0xA8][0xC4][*BR*]P	*S[0xA8][0xC4][BR]P* *BR* represents the brightness value. The default brightness value is 255 or 0xFF at 100% brightness. To set at 75% brightness, the brightness value 0.75*255=191(0xBF)

11. Display Quantity

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

12. Handling Precautions of the module

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

b) Do not press hard on the LCD panel surface. (max2.0kg) In the LCD panel, the gap between two glass plates is kept perfectly even to maintain display properties and reliability. The hard pressure on the LCD panel may cause the following problems. If the pressure is over 2kg/cm^2, the problem don't return to normal Condition.

(1) Ununiformity of color
(2) Disorder of orientation of liquid crystal

Problem (1) returns to normal condition after a while. Problem (2) returns to normal condition by turning the power off and turning on again.
However these operations should be avoided to insure reliability.

c) Do not scratch the polarizer film on the LCD panel surface.

・Do not press or rub the display surface with a hard tool, tweezers, etc.
・For handling, use cotton or conductive gloves so that the display surface is not soiled.
・If dust or dirt soils the display surface, clean it as follows with a soft cloth (deerskin, etc.)

[Dust] Wipe off with a soft cloth. (do not rub.)

[Dirt] Apply clear water to a soft cloth and squeeze hard out of water drops, then lightly wipe off the specified parts. Only if the dirt is hardly wiped off, use isopropyl alcohol or ethanol.
Be careful not to splash the water or the solvents on the edge of polarizer and in the LCD unit.
The polarizer possibly exfoliates due to the solvent and water penetrated between the polarizer and the LCD panel.
Do not use unspecified solvent such as ketone (acetone, etc.) and aromatics (xylene, toluene, etc.)

(Caution) Be careful not to allow the water or solvent to enter the module.
・If saliva or water drops are left for a long period of time, the part may become deformed or discolored.
Wipe off immediately in the same way as for dirt.
・Do not allow oil to adhere to the module since excessive oil is hard to clean.

d) Do not place or contact objects on the display surface for a long period of time.
This may make some parts of the LCD module distorted and the quality of display may deteriorate.

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

f) Be sure to fix the module in the same plane so that the module can be installed without any extra stress such as warp or twist.

g) Take anti-electrostatic measures for assembling the module.
Since the LCD module contains CMOS-ICs, the following points should be observed.

・For assembling the module, operator should be grounded and wear cotton or conductive gloves.
・Floor of work area and work table to assemble the LCD module should be covered with electrostatic shielding in order to discharge static electricity via an earth wire.
・If necessary, ground operation tools (soldering iron, radio pliers, tweezers, etc.).
・Do not take the module out of the conductive bag until the module is assembled.
・Do not assemble the module under low humidity (50%RH or less).

h) Ground attachment to the LCD module should be considered, so that influences from EMI and outer noise is minimized.

i) The module has some printed circuit boards (PCBs) on the back side, take care to keep them form any Stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

l) Observe all other precautionary requirements in handling components.

m) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc.. So, please avoid such design

n) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

o) Blow off dust with N2 blower for which static electricity preventive measure has been taken. Ionized air gun is recommended.

p) Do not pull the LED module cable strongly.
If the cable is pulled with the strength of 2kg or more, the cable may be damaged or may lose reliability.

q) Assemble the module into user's system in a dust free environment**.**
Conductive foreign matter adheres to the module may cause failures.

r) Do not pull the connecting cable on the rear face of the LCD module strongly.

s) Adhere to the specified power supply sequence.
If not followed, the CMOS-IC may cause a latch-up, or DC voltage may be applied to the liquid crystal, which cause a failure or serious deterioration in display quality.

t) Do not operate the LCD module when condensation occurs.
If the LCD module is operated when condensation is on the terminals of the LCD panel, the terminals cause electrochemical reaction, and may reach disconnection. Condensation easily occurs especially when the module is moved from cold environment to warm environment.

u) Be careful not to be interfered with FRC.
This LCD unit adopts Frame rate control (FRC) to adjust its Gamma curve.Be careful not to be interfered.

v) Be sure to input the control signals at the correct timing.
If control signals (DCLK, ENAB) are not input, or if the timing is out of the specified timing, DC voltage may be applied to the liquid crystal and, as a result, cause image sticking or deterioration of contrast.

13.Precautions in regards of designing module mounting

(a) Excessive force should not be applied to the screen or the rear side of the LCD module.
Excessive pressure on the screen caused by the installation of the LCD module may deteriorate display quality and reliability.
Brightness uniformity and the reliability of LED may decrease if the pressure is applied to the backlight module.

(b) Avoid twisting and bending the LCD module.
Excessive twist and bend may damage display quality and reliability.

(c) Avoid extending the power cable between the LCD module and LED drive circuit.
This may cause the backlight not to light.

(d) Keep the backlight cable apart from the metal enclosure of the LCD module.
When frequency current for backlight driving leak to the metal enclosure, the desired brightness may not be assured.

(e) When Mounting LCD module with M3 screws (x6), tighten the screws with torque below (T.B.D).

(f) This module generates many heat. It is necessary to apply a cooling method in product side.(cooling fun etc.)

(g) If a minute particle enters in the module and adheres to an optical material, it may cause display non-uniformity issue, etc. Therefore, fine-pitch filters have to be installed to cooling and inhalation hole if you intend to install a fan.

(h) Before product design, please ask us about thermal design.

(i) When any question or issue occurs, it shall be solved by mutual discussion.

14. Packing form

a) Piling number of cartons: (2)
b) Packing quantity in one carton : 2 module
c) Carton size : 620(W)×447 (H) ×276(D) mm
d) Total mass of one carton filled with full modules : (6.0) Kg (TYP)
e) Packing form figures are shown in Fig.3

15. Reliability test items

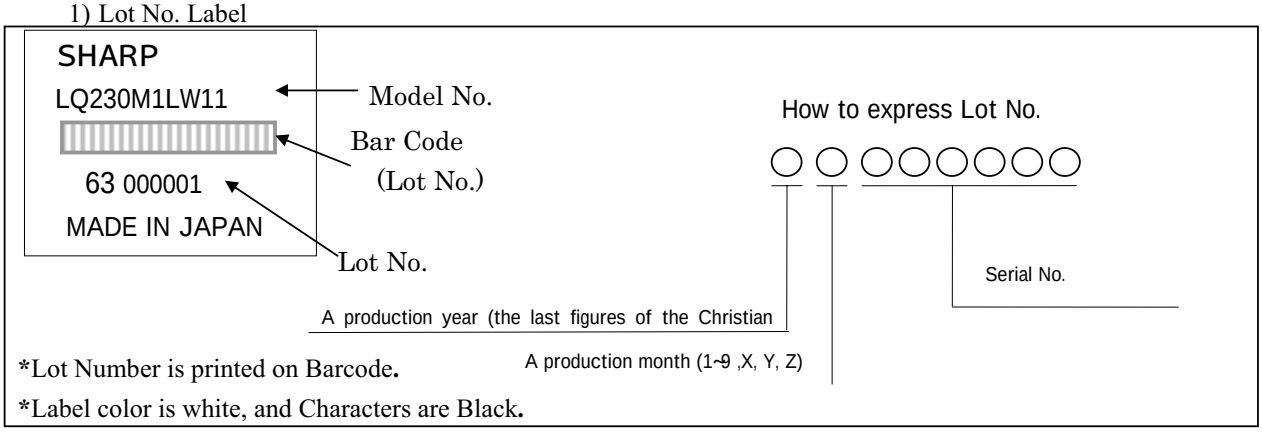
No	Test item	Conditions
1	High temperature storage test	Ta = 60℃ 240h
2	Low temperature storage test	Ta = -25℃ 240h
3	High temperature & high humidity operation test	Ta = 40℃ ; 95%RH 240h (No condensation)
4	High temperature operation test	Ta = 50℃ 240h (The panel temp. must be less than 60℃) * If The panel temp 65℃ MAX, 48h
5	Low temperature operation test	Ta = 0℃ 240H
6	Vibration test (non- operating)	Waveform : Sine wave Frequency : 10～57Hz/Vibration width (one side) : 0.075mm : 57～500Hz/Gravity : 9.8m/s^2 Sweep time : 11minutes 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 : 11ms, sine wave Direction : ±X, ±Y, ±Z, once for each direction.
8	Thermal shock test (non- operating)	Ta=-25℃～60℃ ; 5 cycles Test period : 10 hours (1 hour for each temperature)

【Result evaluation criteria】

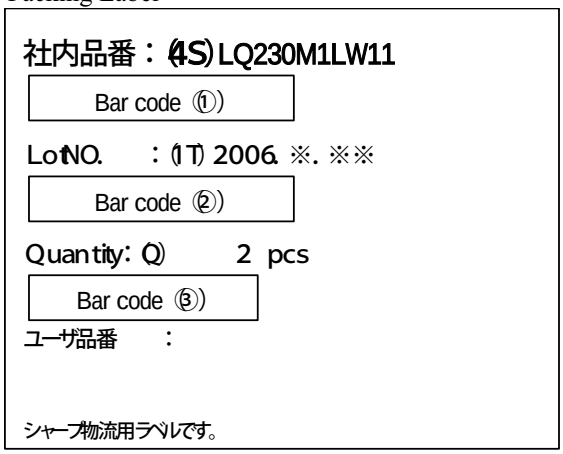
Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function.

16. Others

1) Lot No. Label



2) Packing Label



① Model No. (LQ230M1LW11)

② Lot No. (Date)

③ Quantity

3) 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.

4) Do not disassemble or remodel the LCD module.
Disassembly or remodeling of the LCD module may result in malfunctions or deterioration of the display quality and reliability.

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

6) Turn off the LED circuit for back light before turning off the power source for the controller.

7) The chemical compound which causes the destruction of ozone layer is not being used.

8) Label of using material information
It is displaying the material of the optical parts with the label in the module back.
(T.B.D)

17. Carton storage conditions

Temperature	0℃ to 40℃
Humidity	95%RH or less
Reference condition :	20℃ to 35℃ , 85%RH or less (summer)
:	5℃ to 15℃ , 85%RH or less (winter)
	・the total storage time (40℃,95%RH) : 240H or less
Sunlight	Be sure to shelter a product from the direct sunlight.
Atmosphere	Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected.
Notes	Be sure to put cartons on palette or base, don't put it on floor, and store them with removing from wall Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment
Storage period	1 year

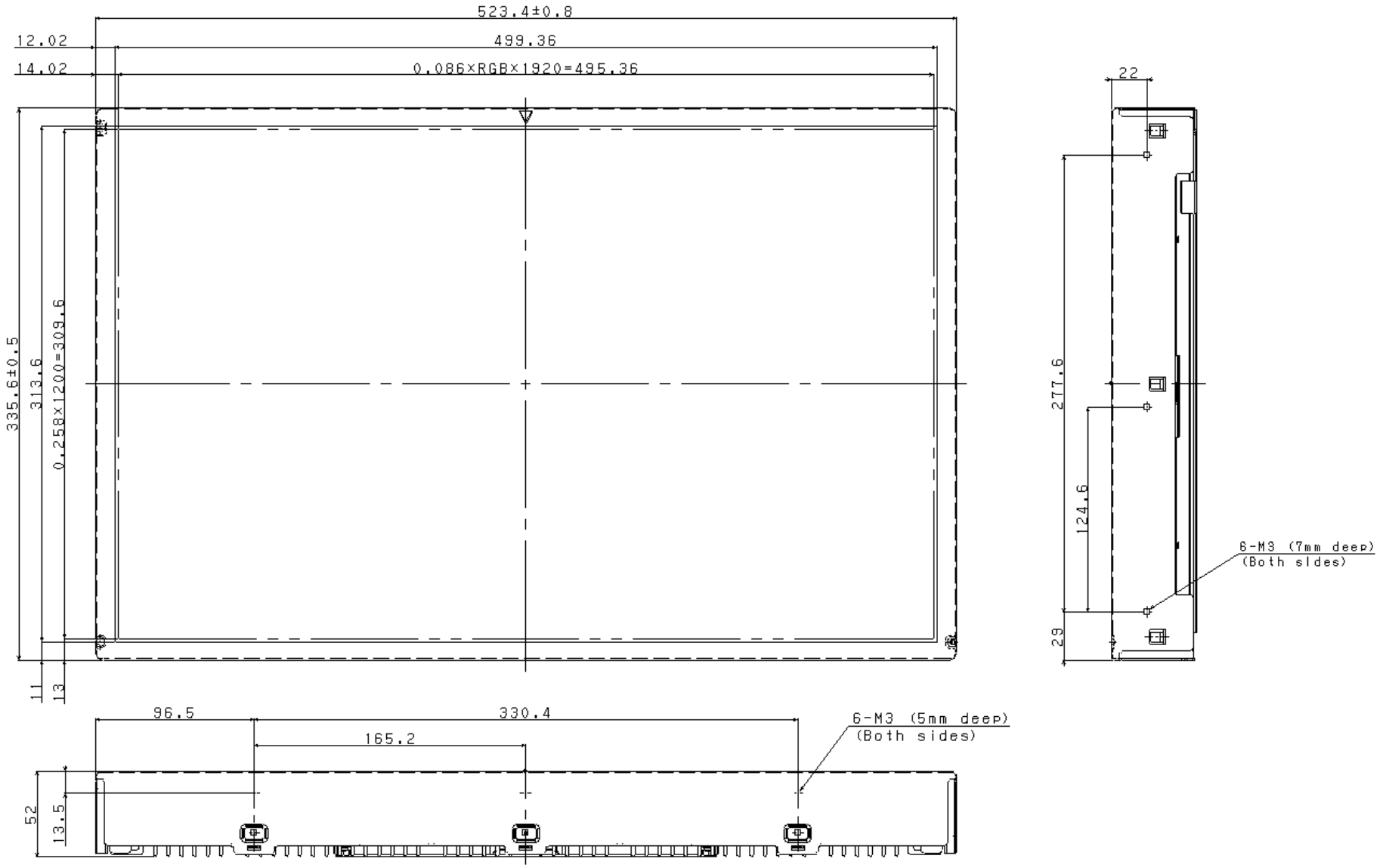


Fig.1 LQ230M1LW11 OUTLINE DIMENSIONS (FRONT SIDE)

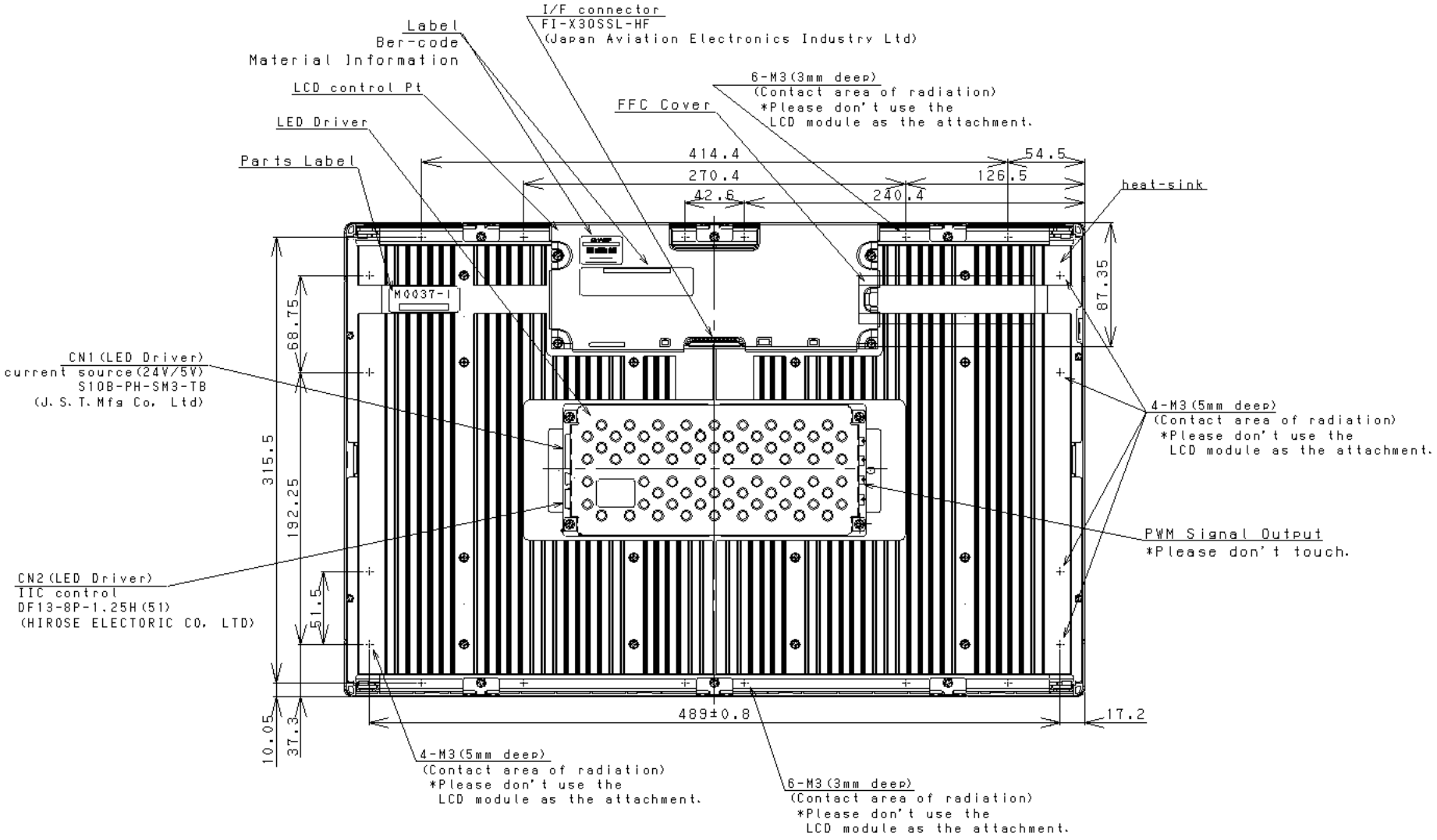


Fig.2 LQ230M1LW11 OUTLINE DIMENSIONS (REAR SIDE)

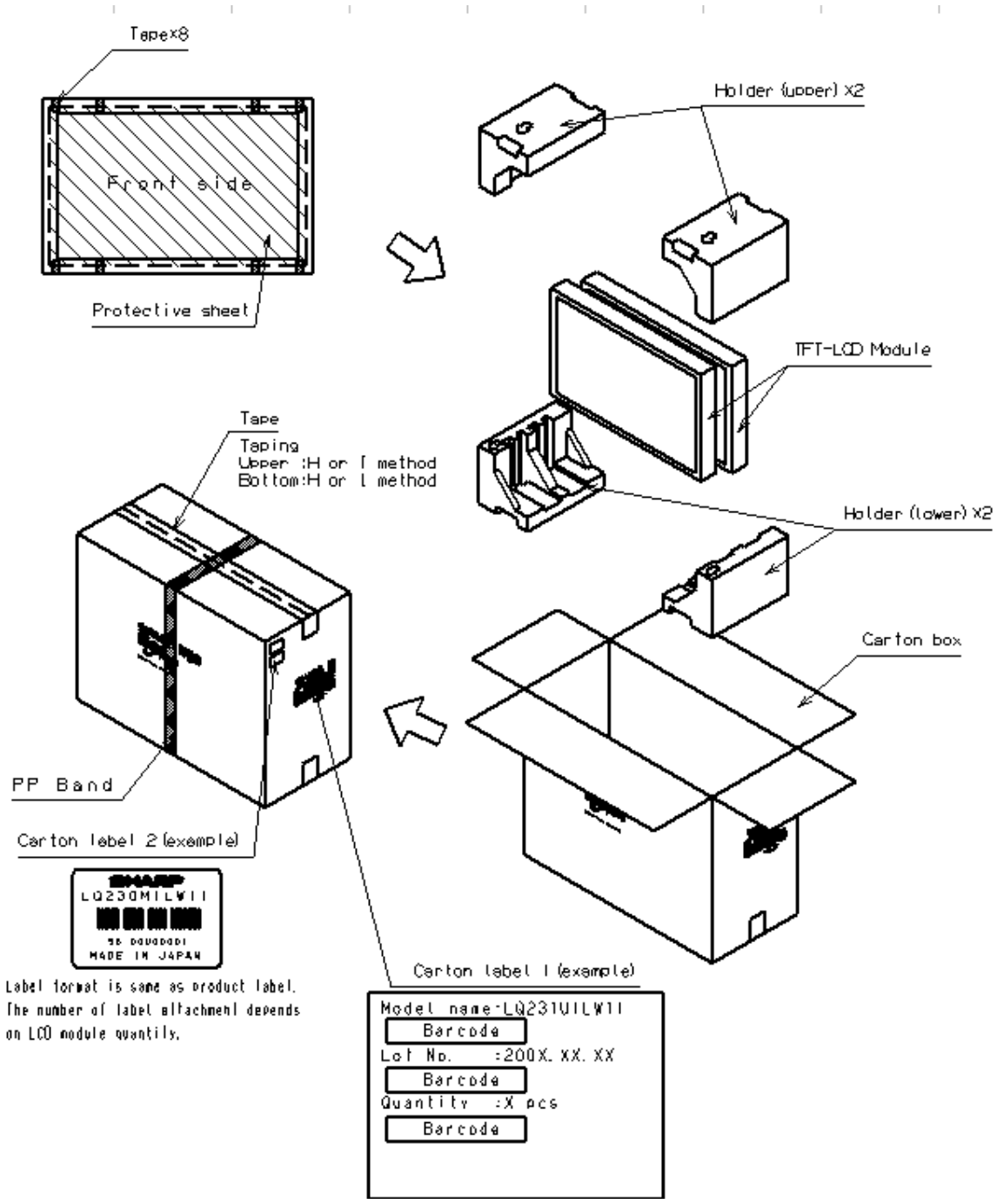


Fig.3 PACKING FORM

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- Traffic signals
- Alarm equipment
- Gas leakage sensor breakers
- Various safety devices etc.

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- Nuclear power control equipment
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