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		Tenri Liquid Crystal Display
		Group

/ DEVICE SPECIFICATION FOR

TFT-LCD Module

MODEL No.

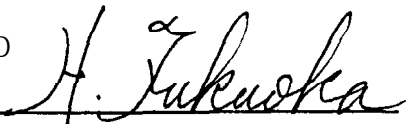
LQ10S21

CUSTOMER'S APPROVA

BY

PRESENTED

BY



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Department General Manager

Engineering Department 2

TFT LCD Development Center

TENRI LIQUID CRYSTAL DISPLAY GROW

SHARP CORPORATION

1. Application

This specification applies to color **TFT-LCD** module, LQ10S21.

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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 800 X3X600 dots panel with 262,144 colors by supplying **18** bit data signals (**6bit/color**), four timing signals, **+3.3V** DC supply voltage for **TFT-LCD** panel driving and supply voltage for backlight.

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 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	26 (10.4") Diagonal	cm
Active area	211.2 (H) × 158.4 (V)	mm
Pixel format	800 (H) × 600 (V)	pixel
	(1 pixel = R + G + B dots)	
Pixel pitch	0.264 (H) × 0.264 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	246.5 (W) × 179.4 (H) × 8.0 (D)	mm
Mass	395 ± 10	g
Surface treatment	Anti-glare and hard-coating 2H Low reflection (~ 1.5%)	

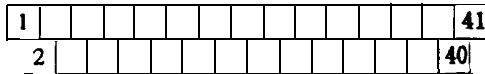
* 1.**Note:** excluding backlight cables.

Outline dimensions is shown in **Fig.1**

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 : DF9MA-41P-1V (Hirose Electric Co., Ltd.)



Mating connector: DF9□-41S-1V (")

□ is A, B or M

CN1 pin arrangement from module surface
(Transparent view)

Pin No.	symbol	Function	Remark
1	GND		
2	CK	Clock signal for sampling each data signal	
3	GND		
4	GND		
5	Hsync	Horizontal synchronous signal	【Note1】
6	Vsync	Vertical synchronous signal	【Note1】
7	GND		
8	R0	R E D data signal (LSB)	
9	R1	R E D data signal	
10	R2	R E D data signal	
11	R3	R E D data signal	
12	R4	R E D data signal	
13	R5	R E D data signal (MSB)	
14	GND		
15	GND		
16	GND		
17	G0	G R E E N data signal (LSB)	
18	G1	G R E E N data signal	
19	G2	G R E E N data signal	
20	G3	G R E E N data signal	
21	G4	G R E E N data signal	
22	G5	G R E E N data signal (MSB)	
23	GND		
24	GND		
25	GND		
26	B0	B L U E data signal (LSB)	
27	B1	B L U E data signal	
28	B2	B L U E data signal	
29	B3	B L U E data signal	
30	B4	B L U E data signal	
31	B5	B L U E data signal (MSB)	
32	GND		
33	GND		
34	GND		
35	ENAB	Signal to settle the horizontal display position	【Note2】
36	Vcc	+3.3V power supply	
37	Vcc	+3.3V power supply	
38	TST	This should be electrically opened during operation	
39	TST	This should be electrically opened during operation	
40	GND		
41	GND		

※The shielding case is connected with GND.

【Note1】 The polarity of both synchronous signals are negative.

【Note2】 The horizontal display start timing is settled in accordance with a rising timing of ENAB signal. In case ENAB is fixed “Low”, the horizontal start timing is determined as described in 7-2. Don’ t keep ENAB “High” during operation.

4-2. 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°C	-0.3 ~ Vcc+0.3	v	【Note1】
+3.3V supply voltage	Vcc	Ta=25°C	0 ~ +6	V	
Storage temperature	Tstg	-	-25 ~ +60	°C	[Note2]
Operating temperature (Ambient)	Topa	-	0 ~ +50	°C	

【Note1】 CK,R0~R5,G0~G5,B0~B5 ,Hsync,Vsync,ENAB

【Note2】 Humidity : 95%RH Max. at Ta≤40°C.

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

No condensation.

6. Electrical Characteristics

6-1 . TFT-LCD panel driving

Ta=25°C

Parameter		Symbol	Min.	Typ.	Max.	unit	Remark
Vcc	Supply voltage	Vcc	+3.0	+3.3	+3.6	V	【Note1】
	Current dissipation	Icc	—	295	560	mA	【Note2】
	Rush current	Iccs	—	—	1.5	A	【Note3】
Permissive input ripple voltage		V _{RP}	—	—	100	mVp-p	Vcc=+3.3V
Input voltage (Low)		V _{IL}	—	—	0.3Vcc	V	【Note4】
Input voltage (High)		V _{IH}	0.7Vcc	-	-	V	
Input current (low)		I _{OL}	—	—	1.0	μA	V _I =0V 【Note3】
Input current (High)		I _{OH1}	—	—	1.0	μA	V _I =3.3V 【Note5】
		I _{OH2}	—	—	30.0	μA	V _I =3.3V 【Note6】

[Note1]

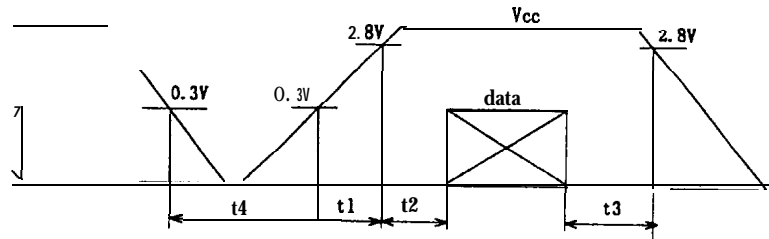
Vcc-turn-on conditions

$0 < t1 \leq 10ms$

$0 < t2 \leq 50ms$

$0 < t3 \leq 1s$

$t4 \geq 1s$

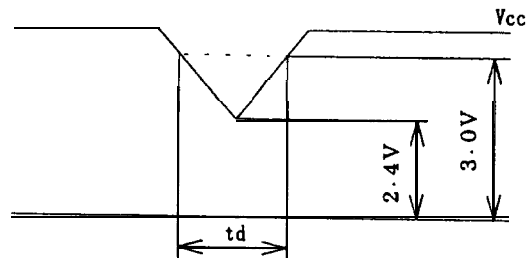


Vcc-dip conditions

1) $2.4V \leq Vcc < 3.0V$

$td \leq 10ms$

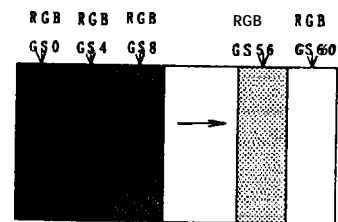
2) $Vcc < 2.4V$



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

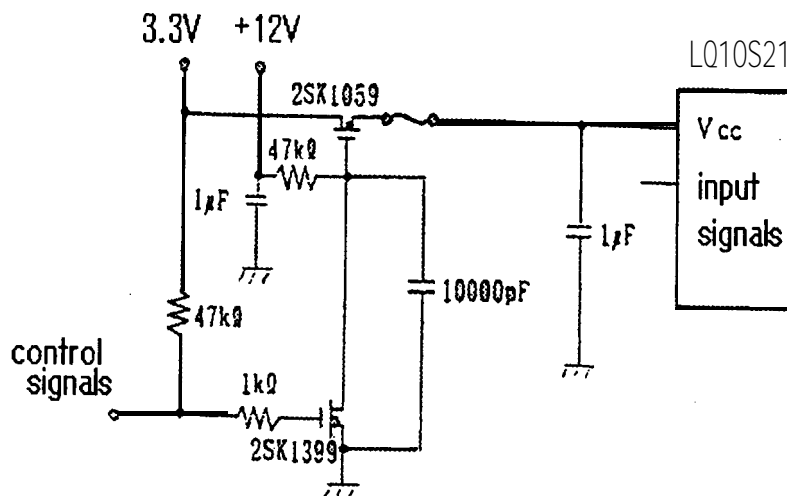
[Note2] Typical current situation: 16-gray-bar pattern.

Vcc=+3.3V

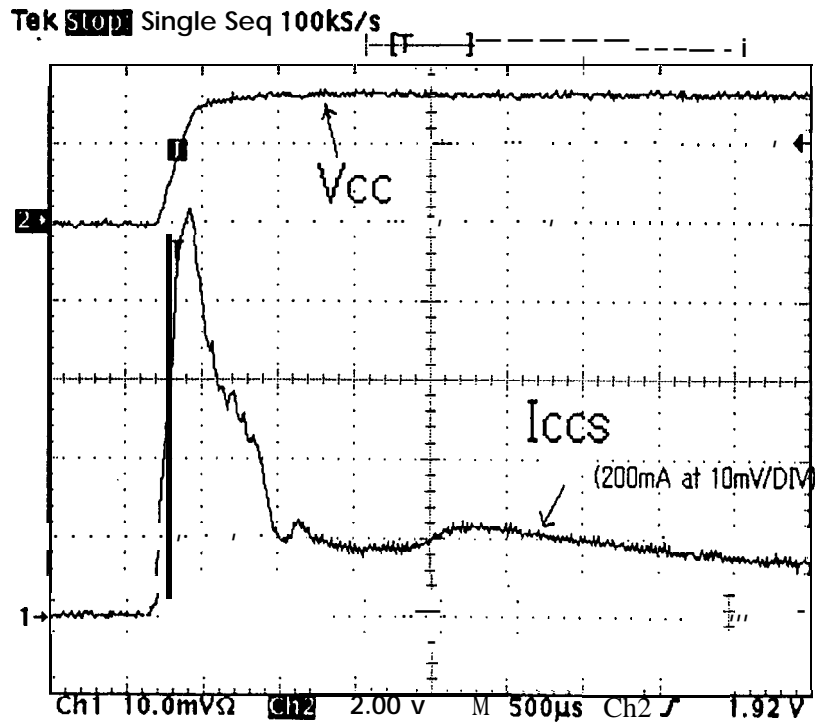


[Note3] Rush current □ easurement current

The rush current shall be □ easured with the method as shown below.



(Definition of rush current)



【Note4】 CK,R0~R5,G0~G5,B0~B5,Hsync,Vsync,ENAB

【Note5】 CK,R0~R5,G0~G5,B0~B5, Hsync,Vsync

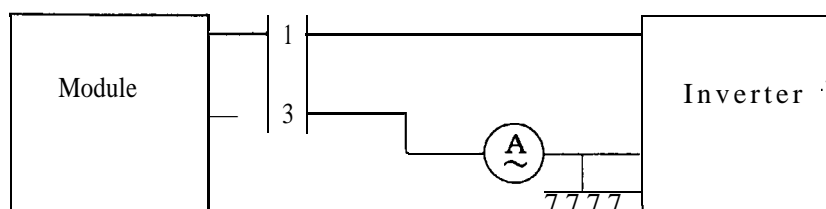
【Note6】 ENAB

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	Min.	Typ.	Max.	unit	Remark
Lamp current range	IL	1.5	2.3	6.0	mArms	【Note1】
Lamp power consumption	PL	—	1.3	—	W	Typical value; $Y_L=70\text{cd/m}^2$
Lamp frequency	FL	20	35	60	KHz	【Note2】
Kick-off voltage	Vs	—	—	1100	Vrms	Ta=25°C
		—	—	1300	Vrms	Ta=0°C
Lamp life time	LL	10000	—	—	hour	【Note4】

【Note1】 1 Lamp current is measured with current meter for high frequency as shown below.



* 3pin is V_{LOW}

【Note2】 Lamp frequency may produce interference with horizontals **ynchronous** 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.

【Note3】 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.

【Note4】 Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of $T_a=25^{\circ}\text{C}$ and $I_L=5.5\text{mA rms}$.

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

② Kick-off voltage at $T_a=0^{\circ}\text{C}$ exceeds maximum value, 1300 V rms .

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

Timing diagrams of input signal are shown in Fig.2.

1. Timing characteristics

Parameter	Symbol	Min.	Typ.	Max.	unit	Remark
Clock	Frequency	$1/T_c$	40.0	42.0	MHz	
	High time	T_{ch}	5	—	ns	
	Low time	T_{cl}	5	—	ns	
	Duty ratio	T_h/T	40	50	60	%
Data	Setup time	T_{ds}	3	—	ns	
	Hold time	T_{dh}	10	—	ns	
Horizontal sync. signal	Cycle	T_H	20.8	26.4	—	μs
			832	1056	—	clock
	Pulse width	T_{Hp}	2	128	200	clock
Vertical sync. signal	Cycle	T_V	628	666	798	line
	Pulse width	T_{Vp}	2	4	6	line
Horizontal display period	T_{Hd}	800	800	800	clock	
Hsync-Clock phase difference	T_{Hc}	10	—	T_c-10	ns	
Vertical data start position	T_{Vs}	23	23	23	line	
Hsync-Vsync phase difference	T_{Vh}	0	—	T_H-T_{Hp}	clock	

Note) In case of lower frequency, the deterioration of display quality, flicker etc., may be occurred.

7-2. Horizontal display position

The horizontal display position is determined by ENAB signal and the input data **corresponding** to the rising edge of ENAB signal is displayed at the left end of the active area.

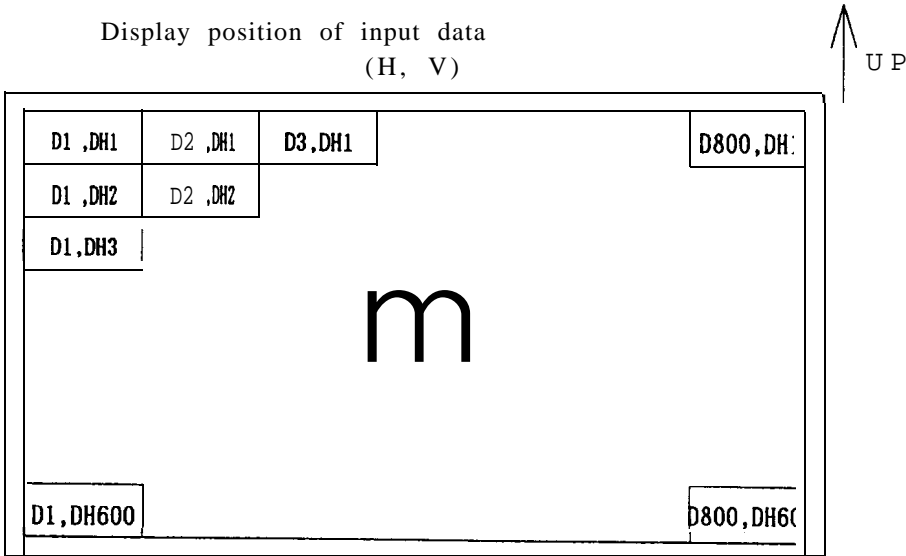
Parameter		symbol	Min.	Typ.	Max.	unit	Remark
Enable signal	Setup time	Tes	5	-	Tc-10	ns	
	Pulse width	Tep	2	800	Th-10	clock	
Hsync-Enable signal phase difference		THE	58	88	170	clock	

Note) When ENAB is fixed “Low”, the display starts from the data of **C88(clock)** as shown in Fig.2. Be careful that the module does **not** work when ENAB is fixed “High”.

7-3. Vertical display position

The vertical display position, Tvs. is fixed “23” (line).

7-4. Input Data Signals and Display Position on the screen



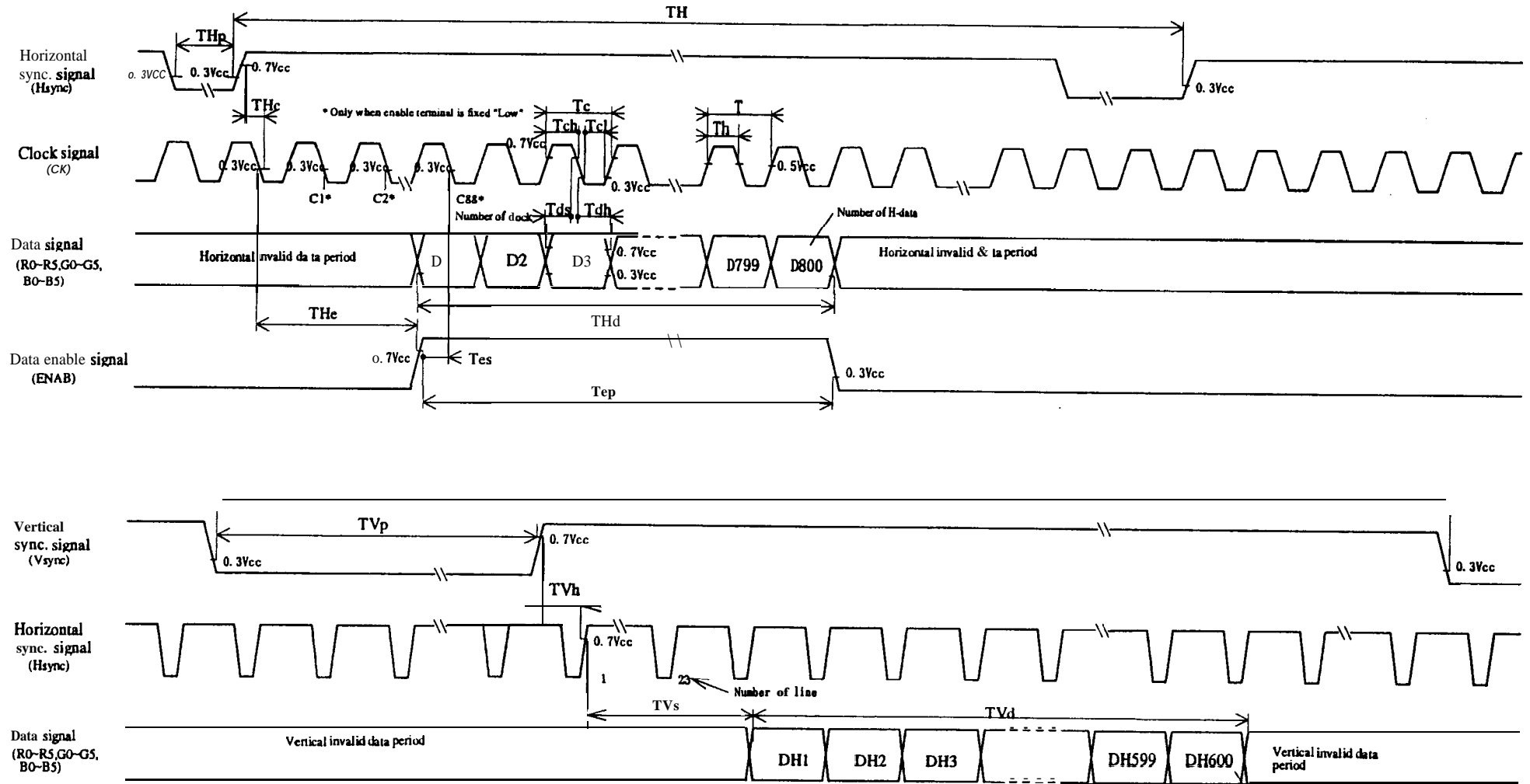


Fig.2 Input signal waveform

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

Colors & Gray scale	Data signal																			
	GrayScale	RO	R1	R2	R3	R4	R5	GO	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5	
Basic Color	Black	—	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
	↑	↓				↓					↓					↓				
	↓	↓				↓					↓					↓				
	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	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
	↑	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°C, Vcc=+3.3V

Parameter		symbol	Condition	Min.	Typ.	Max.	unit	Remark
Viewing angle range	Horizontal	021,022	CR>10	35	—	—	Deg.	【Note1,4】
	Vertical	$\theta 11$		10	—	—	Deg.	
		$\theta 12$		30	—	—	Deg.	
Contrast ratio		C Rn	$\theta = 0^\circ$	150	—	—	【Note2,4】	
		C Ro	optimum viewing angle	—	300	—		
Response time	Rise	τr	$e = 0^\circ$	—	30	—	m s	【Note3,4】
	Decay	τd		—	50	—	m s	
Chromaticity of white		X	$e = 0^\circ$	0.263	0.313	0.363	【Note4】	
		Y		0.279	0.329	0.379		
Luminance of white 【Note4】		Y_{L1}		50	70	—	cd/m ²	$I_L=2.3mA_{rms}$
		Y_{L2}		—	180	—	cd/m ²	$I_L=5.5mA_{rms}$
White Uniformity		δw		—	—	1.45	【Note5】	

※The measurement shall be executed 30 minutes after lighting at rating, (typical condition: $I_L=2.3mA_{rms}$)

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

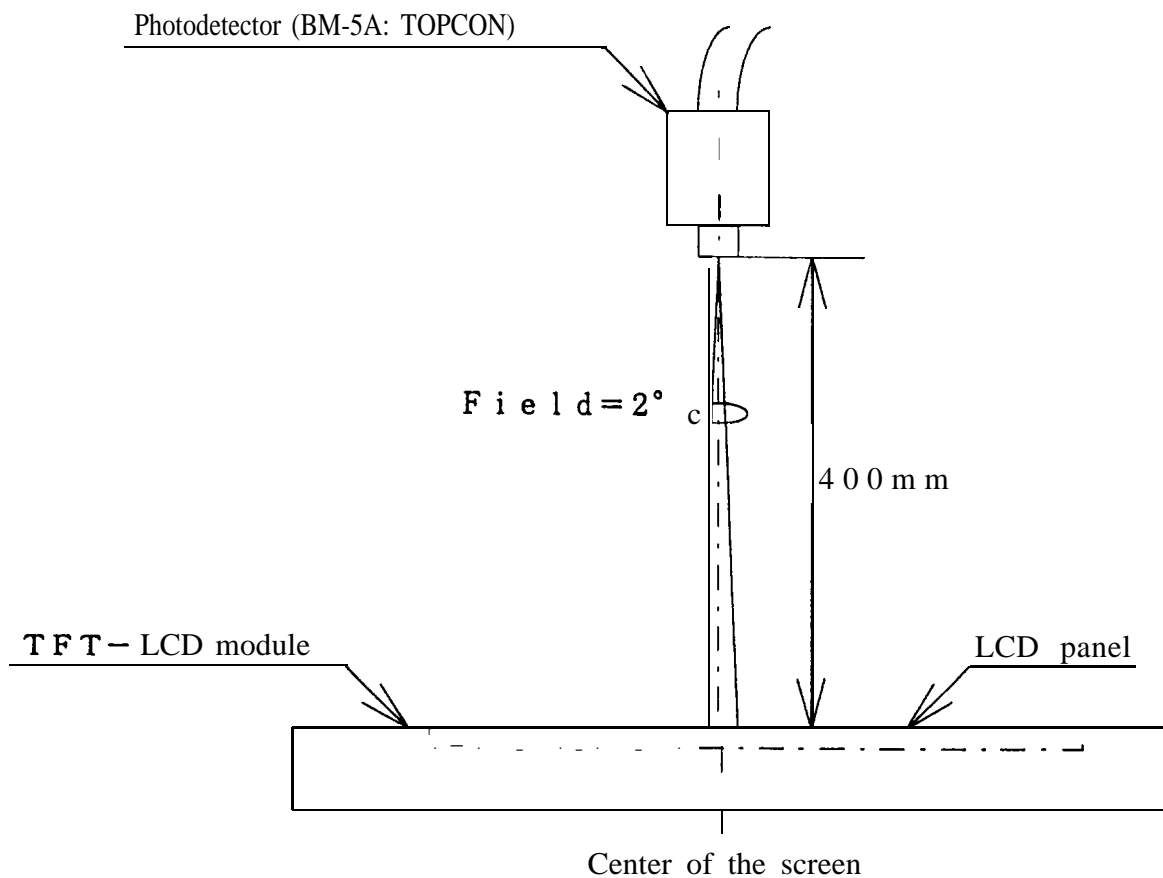
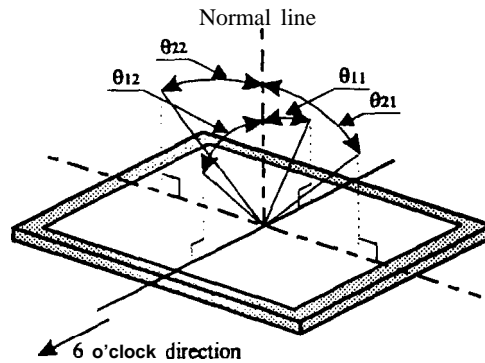


Fig. 3 Optical characteristics measurement method

[Note1] Definitions of viewing angle range



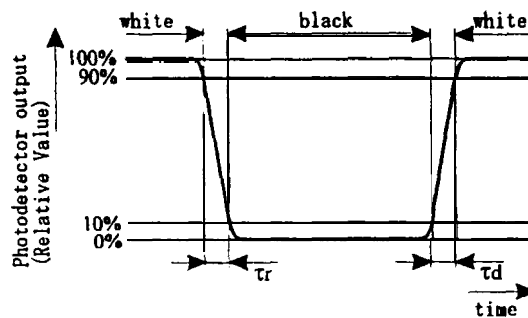
[Note2] Definition of contrast ratio:

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:

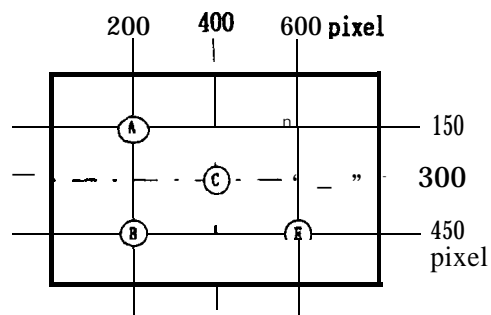
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



[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) Package quantity in one carton: lopes
- c) Carton size : 298(W) × 295(H) × **362(D)mm**
- d) Total mass of one carton filled with **full** modules : **5800g**

Packing form is shown in **Fig.4**

13. Reliability test items

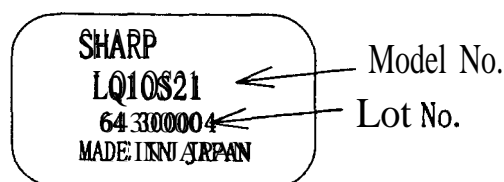
No.	Test item	Conditions
1	High temperature storage test	Ta=60°C 240h
2	Low temperature storage test	Ta=-25°C 240h
3	High temperature & high humidity operation test	Ta=40°C ; 95%RH 240h (No condensation)
4	High temperature operation test	Ta=50°C 240h (The panel temp. must be less than 60°C)
5	Low temperature operation test	Ta=0°C 240H
6	Vibration test (non- operating)	Frequency: 10~57Hz/Vibration width (one side) :0.075mm : 58~500Hz/Gravity:9.8m/s ² 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: 1 lms, sine wave Direction : ±X, ±Y, ±Z once for each direction.

[Result Evaluation Criteria]

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

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.

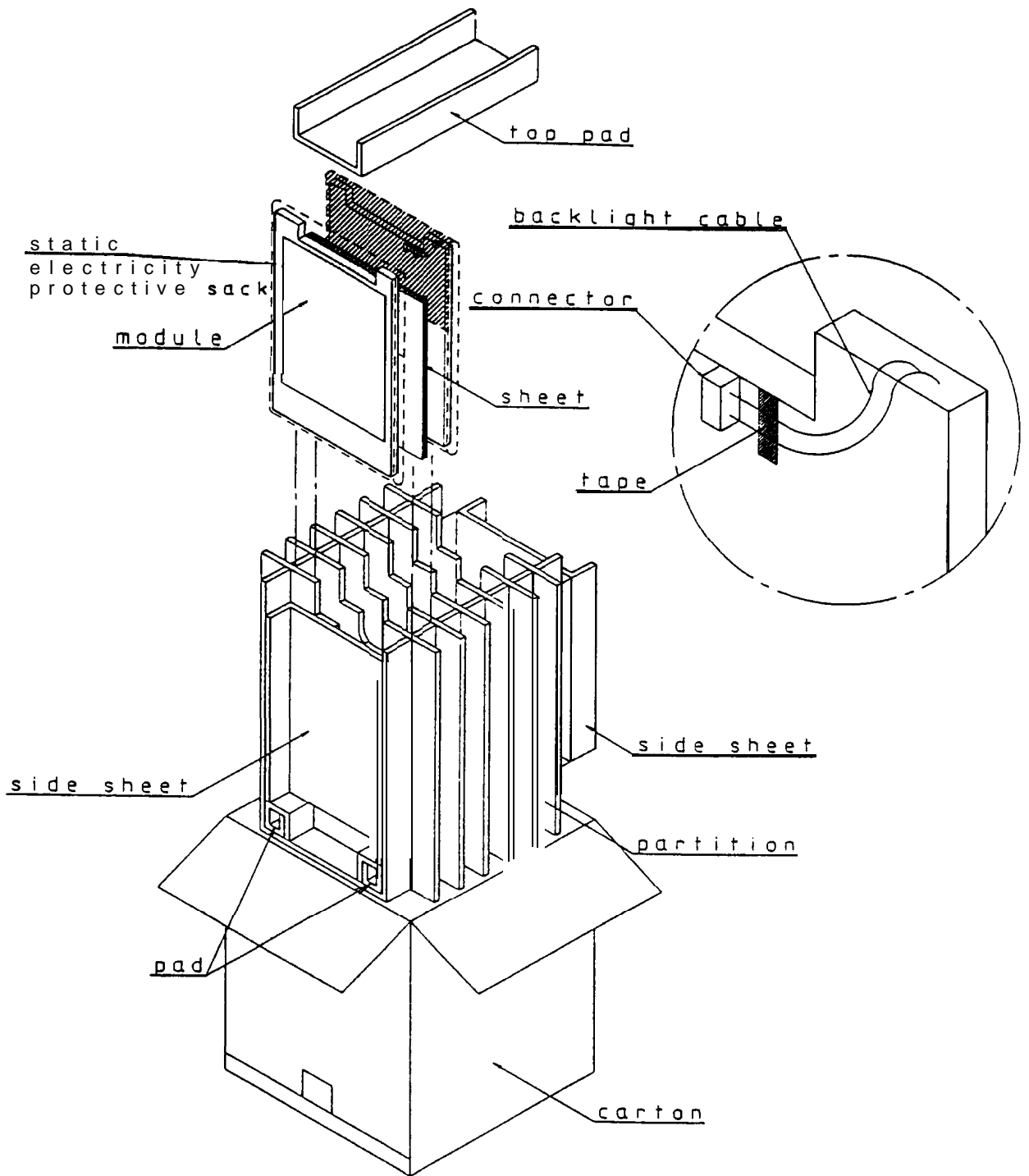
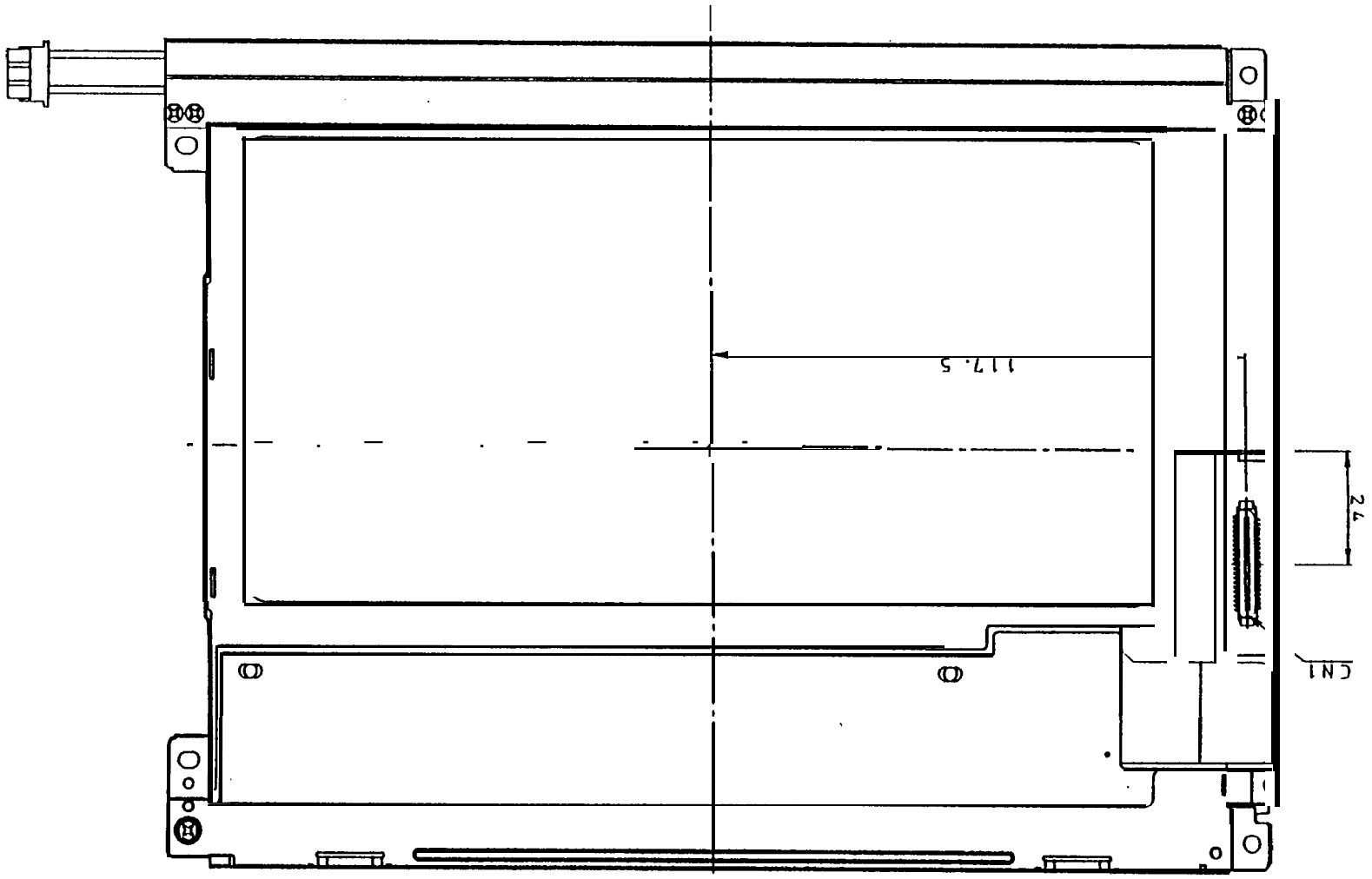


Fig4: packing farm

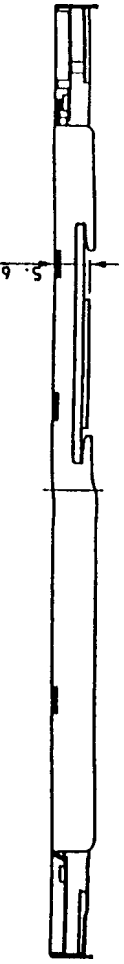
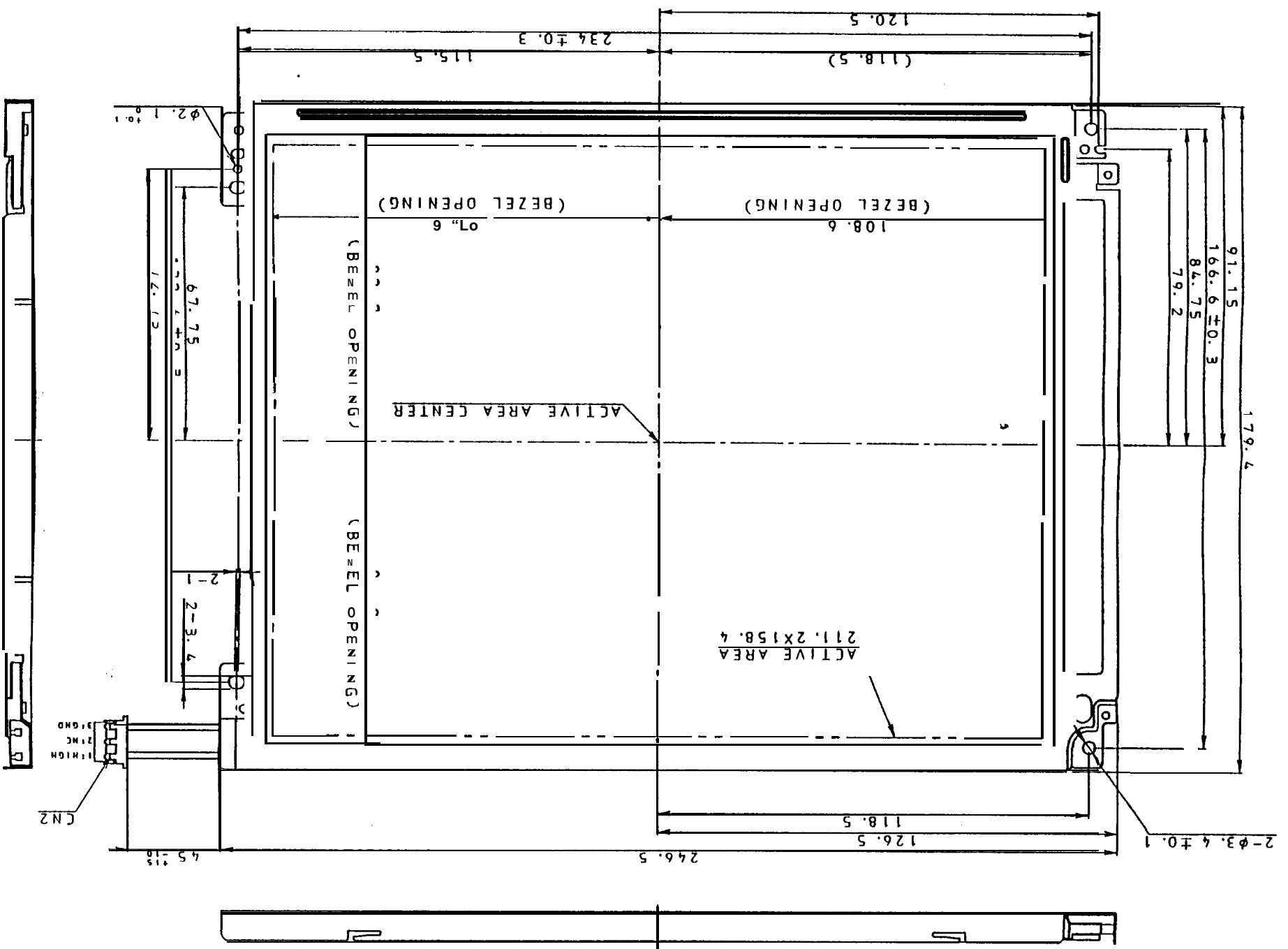
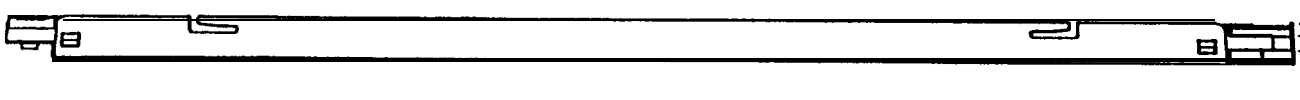
Fig 1 OUTLINE DIMENSIONS

CN2:CCFT CONNECTOR
 BHR-02VS-1(JST)
 CN1: INTERFACE CONNECTOR
 DF9B-41P-1V(HIROSE)

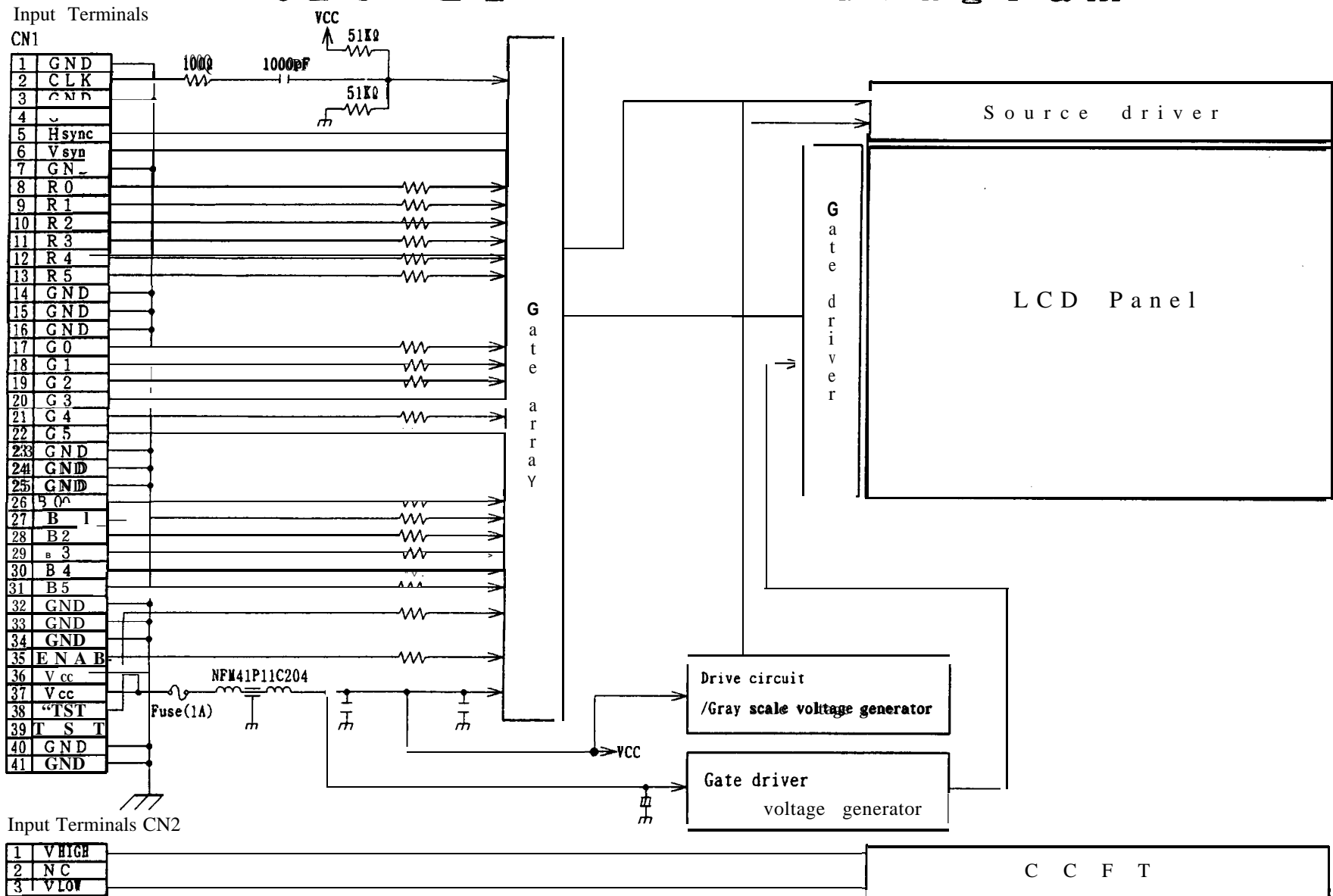
NOTES:UNSPECIFIED TOLERANCE 1 0 BE ±0.5mm



B.5MAX
 5.6
 2.5



LQ10S21 Block diagram



Note) This block diagram is reference.