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NARA LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

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ENGINEERING DEPARTMENT
LCD MONITOR MARKETING CENTER

SPECIFICATION

DEVICE SPECIFICATION FOR

XGA TFT Analog Interface Board

MODEL No.

NL-RC01

CUSTOMER'S APPROVAL

DATE

BY

PRESENTED

BY

M. ISE

General Manager

Engineering Department

LCD Monitor Marketing Center

NARA LIQUID CRYSTAL DISPLAY GROUP

SHARP CORPORATION

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The XGA TFT analog interface (I/F) board was developed and manufactured to be used for office automation (OA) equipment.

When the I/F board is used for transportation (airplane, train, car, etc.), security, calamity protection and the other safety equipment which requires higher reliability and safety, please consider and adopt system total and equipment total safety designs such as fail safe and redundancy functions

We have no intention that the I/F board is used for applications which require the extreme level of reliability and safety such as spaceship, trunk communications network, control systems for atomic reactor, medical controlling life. Please do not use for the above applications.

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This interface has basically developed for JAPAN domestic general users. It might be impossible for us to provide documents and/or evidence of material for foreign countries' safety regulation such as UL to the users depending upon items.

The purpose of this interface development is for our LCD monitor production. Therefore, by the time of the LCD monitor's discontinuation, the production of interface will be also discontinued. 6 months advance notice will be provided for the discontinuation of the product. Then, please give an order for the last time for total future requirement.

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1. Application of the document:

The specification is for Sharp's XGA TFT analog I/F board which model No. is NL-RC01.

2. Outline and Features:

a) This is an interface to connect analog RGB signals with XGA (horizontal 1,024 × vertical 768 pixels) TFT LCD module.

b) This has the multi-Sync/multi-display function to cover VGA (horizontal 640 × vertical 480 pixels) through maximally XGA resolution.

· VESA standard mode is covered.

· VGA and SVGA can be expanded close to XGA.

(At no expansion, display is automatically treated with a centering function.)

c) Simultaneously, 260k colors can be displayed (by 6 bit per color (RGB)).

d) Display timing and RGB gain tuning can be adjusted by OSD guide functions with key switch operation and the adjusted values are memorized into built-in EEPROM.

e) This unit has a power saving function. When one or both of Hsync and Vsync signal does not come, it becomes the power saving mode.

f) The operation voltage is +12V.

g) The key switches for OSD adjustment, the power switch and brightness control are not built-in on the unit, so please prepare them at user side.

3. Absolute Maximum Rating:

Item	Symbol	Condition	Rating	Unit
Input Voltage	POWER	Ta=25°C	+13.2	V

4. Specifications:

a) Applicable Video Timing and Expansion Ratio:

Display Mode	Hsync	Vsync	Dot Frequency	Expansion	When No Expansion	
V E S A	VGA	31.5 kHz	60 Hz	25.175 MHz	×1.6	Centering
	640×480	37.9	72	31.5	1.6	Centering
		37.5	75	31.5	1.6	Centering
		SVGA	35.1	56	36.0	1.25
	800×600	37.9	60	40.0	1.25	Centering
		48.1	72	50.0	1.25	Centering
		46.9	75	49.5	1.25	Centering
		XGA	48.4	60	65.0	1.0
	1024×768	56.5	70	75.0	1.0	-
60.0		75	78.75	1.0	-	
US TEXT						
720×400	31.5	70	28.3	1.4	Centering	
*POWER MAC						
640×480	35.0	67	30.5	1.6	Centering	
832×624	49.7	74.6	57.3	1.0	Centering	
1024×768	60.2	75	80.0	1.0	-	

Remark *: The frequencies for POWER MAC are for reference. A MAC conversion adapter is necessary to connect the unit with POWER MAC.

b) Applicable LCD Module:

13.8" XGA (horizontal 1,024 × vertical 768 pixels) TFT Color LCD modules which model No. is LQ14X03.

c) A/D Conversion:

6 bit per color (RGB)

A/D analog input level(DC2.0~4.0V) } at the time of input for each RGB signal
A/D setting level (DC2.0~4.1V) } for 0.7Vp-p(TYP)

d) Input Terminals:

1) Signal Input Terminal:

- Analog RGB Signals : 0.7Vp-p/75 Ω
- Vsync/Hsync Signals: TTL Level (+/-)

2) Power Input Terminal:

- DC+12V

3) Key Switch for OSD Adjustment, Power Switch and Brightness Control Input Terminals

e) Output Terminals:

- 1) Output Terminal for LCD Module
- 2) Output Terminal for Inverter Unit
- 3) Output Terminal for LED Unit

f) Adjustable Items (for 'OSD):

Symbol	Item
PHASE	Phase
CLOCK	Clock Frequency
H-POS	Horizontal Position
V-POS	Vertical Position
SIZE	Display Size Switching
MODE	VESA/MAC Switching
R-CONT	Red/White Balance
G-CONT	Green/White Balance
B-CONT	Blue/White Balance
CONT	Contrast
BRIGHT	Brightness

Remark *: OSD(On Screen Display)

g) Power Voltage Region:

- $12.0 \pm 0.5V$ (11.5~12.5V)

h) Current:

Power	Condition	Analog I/F Itself w/o Connected with LCD	When Connected with LQ14X03
$12 \pm 0.5V$	Back-up or DPMS	30 mA	-
	Operation	0.7 A	1.75 A

(Note) · Power Supply is required 2A or more (steady state).

· Recommended Inverter unit is used.

i) Environmental Condition:

- Storage Temperature : $-25^{\circ}C \sim +60^{\circ}C$
- Operation Temperature: $0^{\circ}C \sim +50^{\circ}C$

j) Outline Diminution:

- 150 mm (width) × 20 mm (height) × 155 mm (depth)

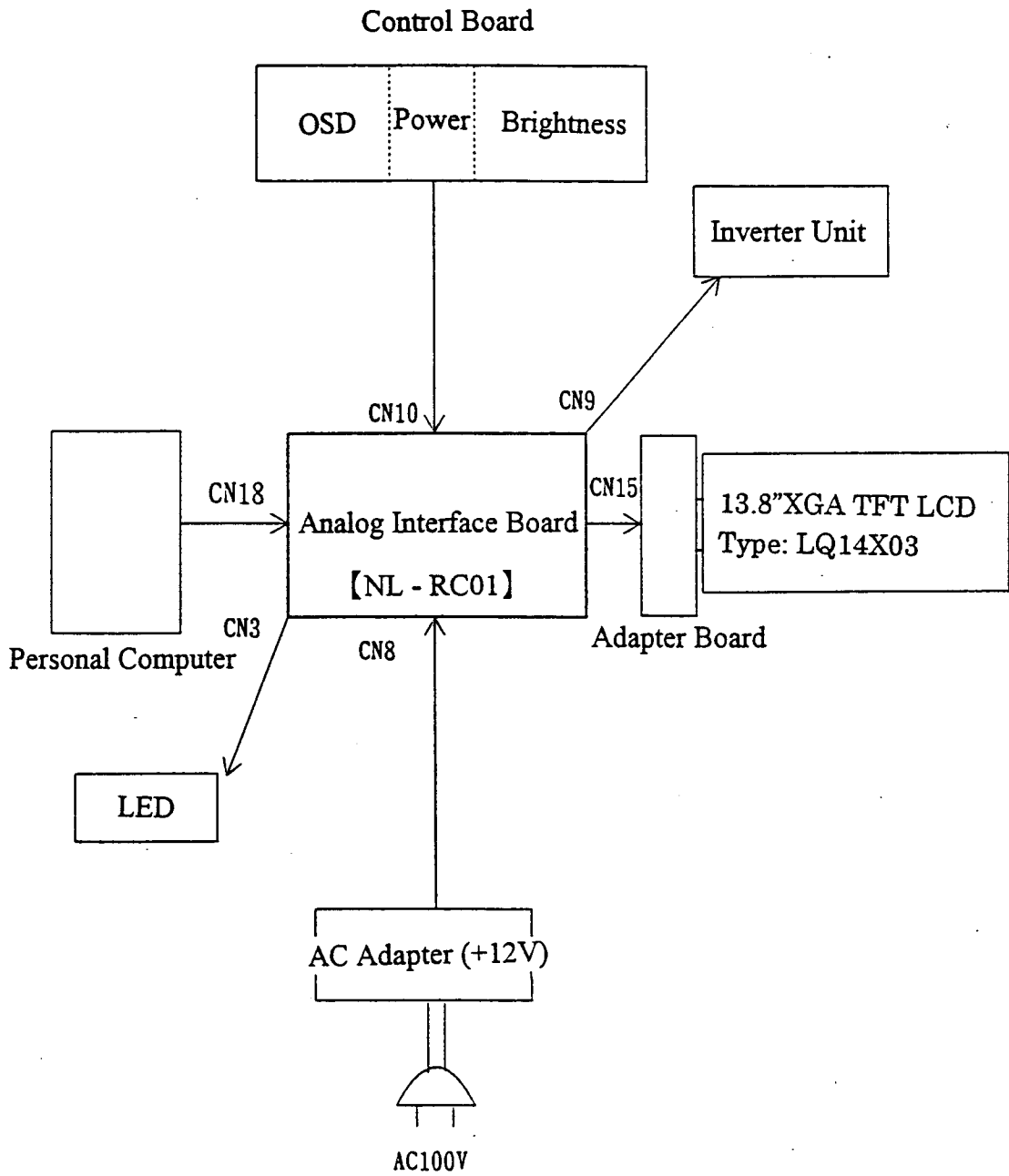
k) Mass:

· 170 g

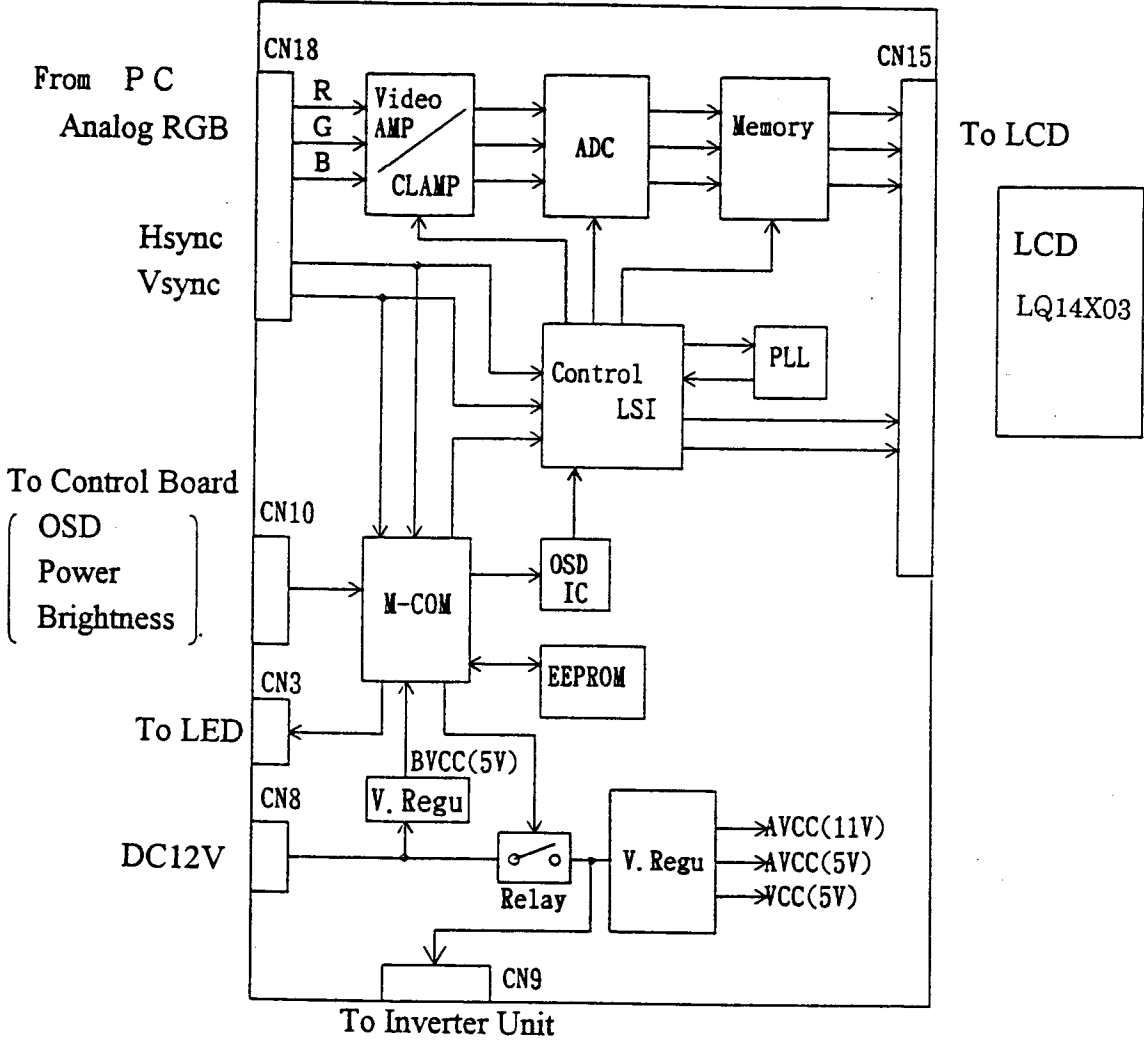
5. Reliability Items:

No.	Test Item	Test Condition -
1	Storage Temperature (High)	240 Hrs at +60°C atmosphere
2	Storage Temperature (Low)	240 Hrs at -25°C atmosphere
3	Operation High Temperature/Humidity	240 Hrs at +40°C and 95%RH atmosphere without dewing
4	Operation Temperature (High)	240 Hrs at +50°C atmosphere
5	Operation Temperature (Low)	240 Hrs at 0°C atmosphere

6. Recommended Block Diagram for the I/F board:



7. System Block Diagram:



XGA Analog I/F Board Block Diagram

8. Input/Output Connectors and Functions:

① CN8 : Power Input Terminal

- Used connector: S4B-PH-SM3-TB (JST)
- Corresponding connector: PHR-4 (JST)

Pin No.	Symbol	Function
1	POWER	DC +12V
2	POWER	DC +12V
3	GND	GND
4	GND	GND

② CN18 : Signal Input Terminals

- Analog RGB Signals : 0.7Vp-p/75 Ω
- Vsync/Hsync Signals: TTL Level (+/-)
- Used connector: KEY-15S-2A3F (JST)
- Corresponding connector: VGA MINI D-SUB 15 Pin

Pin No.	Symbol	Function
1	RED	RED Video Input Signal
2	GREEN	GREEN Video Input Signal
3	BLUE	BLUE Video Input Signal
4		NC
5	RETURN	GND
6	RED RETURN	GND for RED Video Signal
7	GREEN RETURN	GND for GREEN Video Signal
8	BLUE RETURN	GND for BLUE Video Signal
9		NC
10	SYNC RETURN	GND for Sync Signal
11		NC
12		NC
13	H SYNC	Horizontal Sync Signal
14	V SYNC	Vertical Sync Signal
15		NC

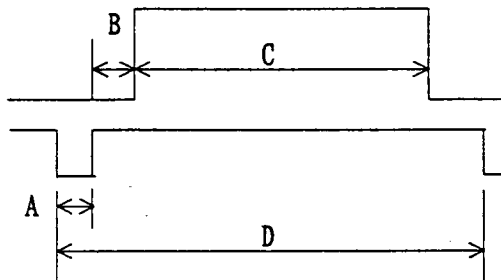
Input Signal Timing

Display Mode	V E S A						
	640×480			800×600			
V.frequency	60Hz	72Hz	75Hz	56Hz	60Hz	72Hz	75Hz
H.frequency	31.5kHz	37.9kHz	37.5kHz	35.1kHz	37.9kHz	48.1kHz	46.9kHz
A (ms)	0.06	0.08	0.08	0.06	0.11	0.13	0.06
B (ms)	0.79	0.53	0.43	0.63	0.61	0.48	0.45
C (ms)	15.25	12.68	12.8	17.07	15.84	12.48	12.80
D (ms)	16.68	13.74	13.33	17.80	16.60	13.90	13.33
E (μs)	3.81	1.27	2.03	2.00	3.20	2.40	1.62
F (μs)	1.59	3.81	3.81	3.56	2.20	1.28	3.23
G (μs)	25.42	20.32	20.32	22.22	20.00	16.00	16.16
H (μs)	31.78	26.41	26.67	28.40	26.40	20.80	21.33

Display Mode	V E S A			US TEXT	Power Macintosh		
	1024×768			720×400	640×480	832×624	1024×768
V.frequency	60Hz	70Hz	75Hz	70Hz	67Hz	74.6Hz	75Hz
H.frequency	48.4kHz	56.5kHz	60.0kHz	31.5kHz	35.0kHz	49.7kHz	60.2kHz
A (ms)	0.12	0.11	0.05	0.06	0.09	0.06	0.05
B (ms)	0.60	0.51	0.47	1.08	1.22	0.84	0.52
C (ms)	15.88	13.60	12.80	12.71	13.80	12.51	12.80
D (ms)	16.67	14.27	13.33	14.27	15.00	13.42	13.41
E (μs)	2.09	1.81	1.22	3.81	2.12	1.12	1.20
F (μs)	2.46	1.92	2.24	1.91	3.09	3.85	2.18
G (μs)	15.75	13.65	13.00	25.42	20.97	14.49	12.75
H (μs)	20.68	17.71	16.66	31.78	28.58	20.10	16.65

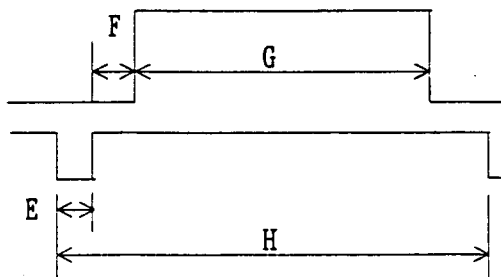
Remark : all to be non-interlaced

Vertical Time



- A: Vertical Sync
- B: Vertical Back Porch
- C: Vertical Display Time
- D: Vertical Total Time
- E: Horizontal Sync
- F: Horizontal Back Porch
- G: Horizontal Display Time
- H: Horizontal Total Time

Horizontal Time



③ CN15 : Output Terminal for LCD Module

· Used connector: IL-FPR-U50S-HF (JAE)

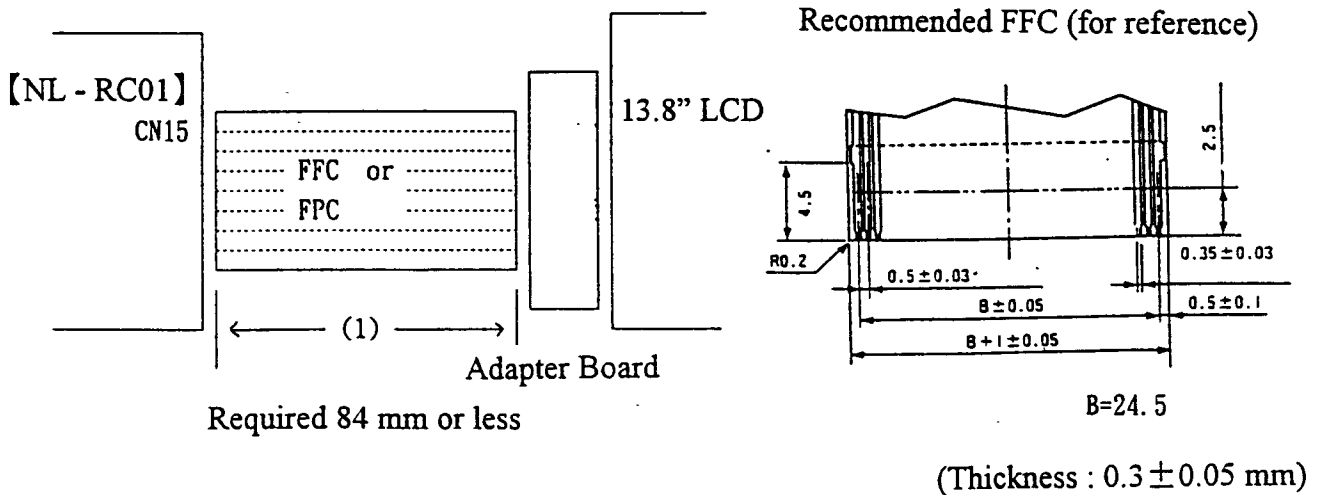
· Corresponding FFC: refer to below

Pin No.	Symbol	Function
1	GND	
2	RB0	RED Data Signal of Even Pixels (LSB)
3	RB1	RED Data Signal of Even Pixels
4	RB2	RED Data Signal of Even Pixels
5	RB3	RED Data Signal of Even Pixels
6	RB4	RED Data Signal of Even Pixels
7	RB5	RED Data Signal of Even Pixels (MSB)
8	GB0	GREEN Data Signal of Even Pixels (LSB)
9	GB1	GREEN Data Signal of Even Pixels
10	GB2	GREEN Data Signal of Even Pixels
11	GB3	GREEN Data Signal of Even Pixels
12	GB4	GREEN Data Signal of Even Pixels
13	GB5	GREEN Data Signal of Even Pixels (MSB)
14	BB0	BLUE Data Signal of Even Pixels (LSB)
15	BB1	BLUE Data Signal of Even Pixels
16	BB2	BLUE Data Signal of Even Pixels
17	BB3	BLUE Data Signal of Even Pixels
18	BB4	BLUE Data Signal of Even Pixels
19	BB5	BLUE Data Signal of Even Pixels (MSB)
20	GND	
21	RA0	RED Data Signal of Odd Pixels (LSB)
22	RA1	RED Data Signal of Odd Pixels
23	RA2	RED Data Signal of Odd Pixels
24	RA3	RED Data Signal of Odd Pixels
25	RA4	RED Data Signal of Odd Pixels
26	RA5	RED Data Signal of Odd Pixels (MSB)
27	GA0	GREEN Data Signal of Odd Pixels (LSB)
28	GA1	GREEN Data Signal of Odd Pixels
29	GA2	GREEN Data Signal of Odd Pixels
30	GA3	GREEN Data Signal of Odd Pixels
31	GA4	GREEN Data Signal of Odd Pixels
32	GA5	GREEN Data Signal of Odd Pixels (MSB)
33	BA0	BLUE Data Signal of Odd Pixels (LSB)
34	BA1	BLUE Data Signal of Odd Pixels

35	BA2	BLUE Data Signal of Odd Pixels	
36	BA3	BLUE Data Signal of Odd Pixels	
37	BA4	BLUE Data Signal of Odd Pixels	
38	BA5	BLUE Data Signal of Odd Pixels (MSB)	
39	GND		
40	DE	Data Enable Signal	*1
41	Vsync	Vertical Sync Signal	*2
42	Hsync	Horizontal Sync Signal	*3
43	GND		
44	CKB	Clock Signal for Sampling Even Pixels Data Signals	*4
45	CKA	Clock Signal for Sampling Odd Pixels Data Signals	*5
46	GND		
47	VCC	DC +5V Power Supply (for LCD)	
48	VCC	DC +5V Power Supply (for LCD)	
49	VCC	DC +5V Power Supply (for LCD)	
50	VCC	DC +5V Power Supply (for LCD)	

*1~5

Pin No.	Symbol	Frequency/Period
40	DE	20.7 μ sec
41	Vsync	16.7 m sec
42	Hsync	20.7 μ sec
44	CKB	32.5 M Hz
45	CKA	32.5 M Hz



(Note) When length of above FPC/FFC(1) is too long, there is a possibility that input timing for the LCD module becomes out of spec.

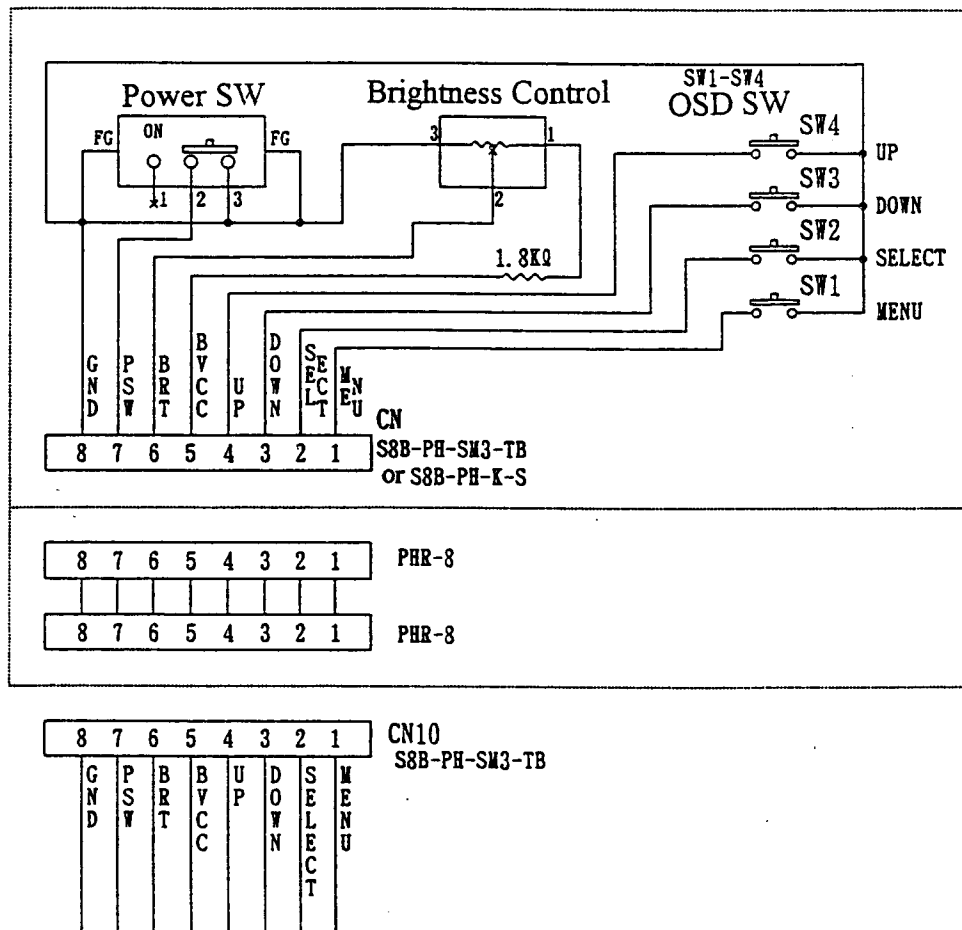
④ CN10 : Key Switch for OSD Adjustment, Power Switch and Brightness Control Input
Terminals

- Used connector: S8B-PH-SM3-TB (JST)
- Corresponding connector: PHR-8 (JST)

Pin No.	Symbol	Function
1	MENU	※
2	SELECT	※
3	DOWN	※
4	UP	※
5	BVCC	Voltage for Adjusting Brightness
6	BRT	Terminal for Adjusting Brightness
7	PSW	Power ON / OFF
8	GND	

Note※ : please refer to "10. Display Adjustment Operation Procedure:" for pin Nos. 1~4.

【Recommended Control Circuit】



(Note) Please use Lock switch for the POWER-SW. The brightness control is to be able to change 0 Ω ~ 10K Ω and "D Characteristics" model is recommended.

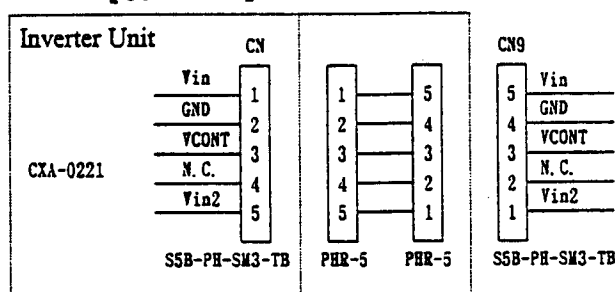
⑤ CN9 : Output Terminal for Inverter Unit

- Used connector: S5B-PH-SM3-TB (JST)
- Corresponding connector: PHR-5 (JST)

Pin No.	Symbol	Function
1	Vin2	Supply Voltage for Inverter unit (DC +5V)
2	N.C.	
3	VCONT	Voltage for Adjusting Backlight Brightness
4	GND	
5	Vin	Supply Voltage for Inverter unit (DC +12V)

(Note) Recommended Inverter : CXA-0221 (TDK)

[Connection]



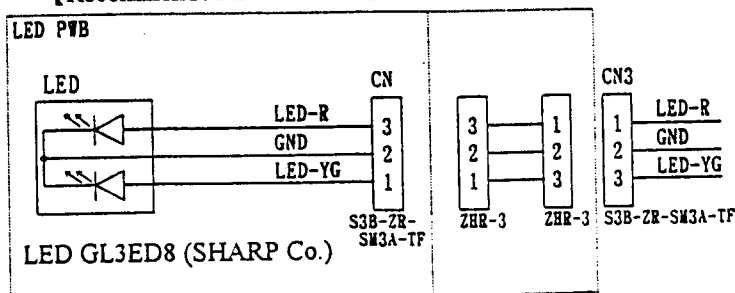
(Note) Please use a suitable inverter unit for the backlight unit of the LCD module.
Also, please sufficiently confirm when above recommended inverter is used.

⑥ CN3 : Output Terminal for LED Unit

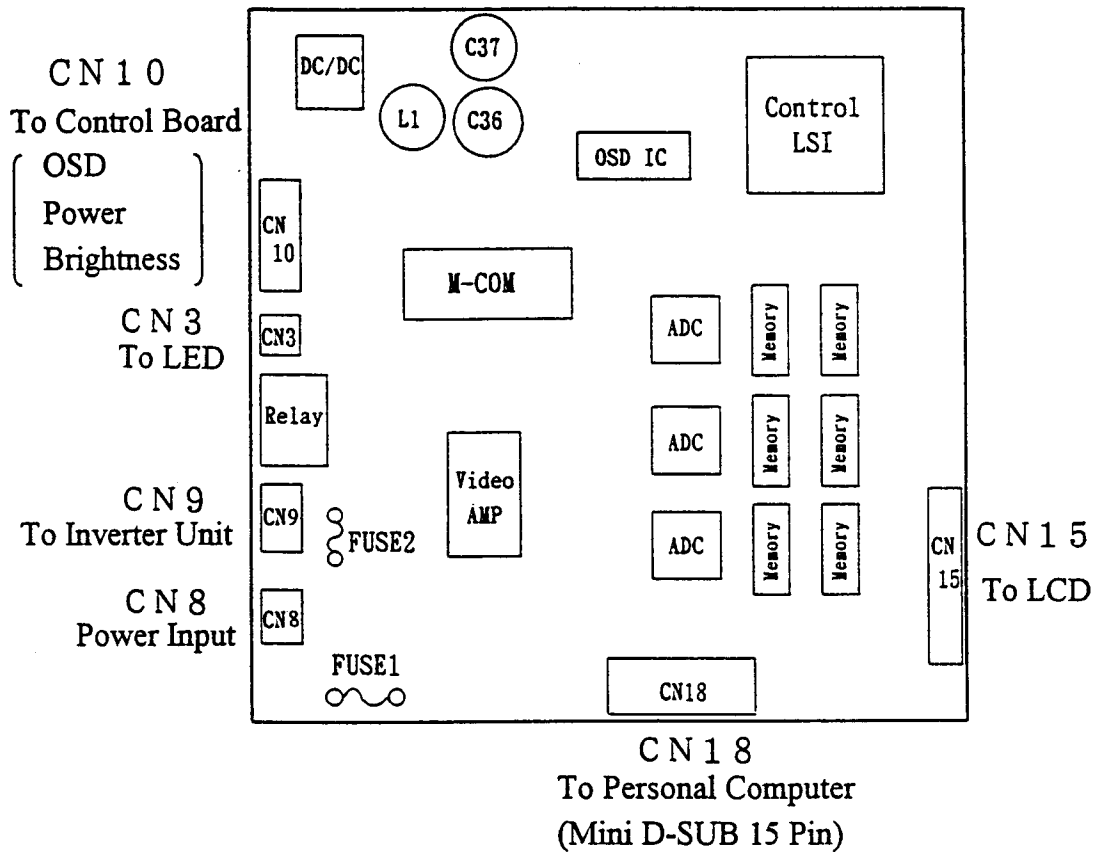
- Used connector: S3B-ZR-SM3A-TF (JST)
- Corresponding connector: ZHR-3 (JST)

Pin No.	Symbol	Normal Mode	Power Save Mode
1	LED-R	Low	High
2	GND	-	-
3	LED-YG	High	High

[Recommended LED Circuit]



9. Input/Output Connectors Layout:



10. Display Adjustment Operation Procedure:

The Adjusting Menu

Items 1	Items 2
PHASE	R-CONT
CLOCK	G-CONT
H-POS	B-CONT
V-POS	CONT
SIZE(NORM EXP)	BRIGHT
MODE(VESA MAC)	

The setting procedure based on the recommended circuit diagram in Page 10 is as follows.
The setting switches are below;

1) MENU:

To display the adjustment menu. Also, to switch above item 1→ 2→ None→ 1→ 2→ None . . . respectively by each push.

2) SELECT:

To select the setting items up to down.

3) UP:

To increase value of selected item. At the maximum of the valuable region, the further switching is neglected. Also, at SIZE switching, it becomes expansion mode and at VESA/MAC switching, it becomes MAC mode.

4) DOWN:

To decrease value of selected item. At the minimum of the valuable region, the further switching is neglected. Also, at SIZE switching, it becomes normal mode and at VESA/MAC switching, it becomes VESA mode.

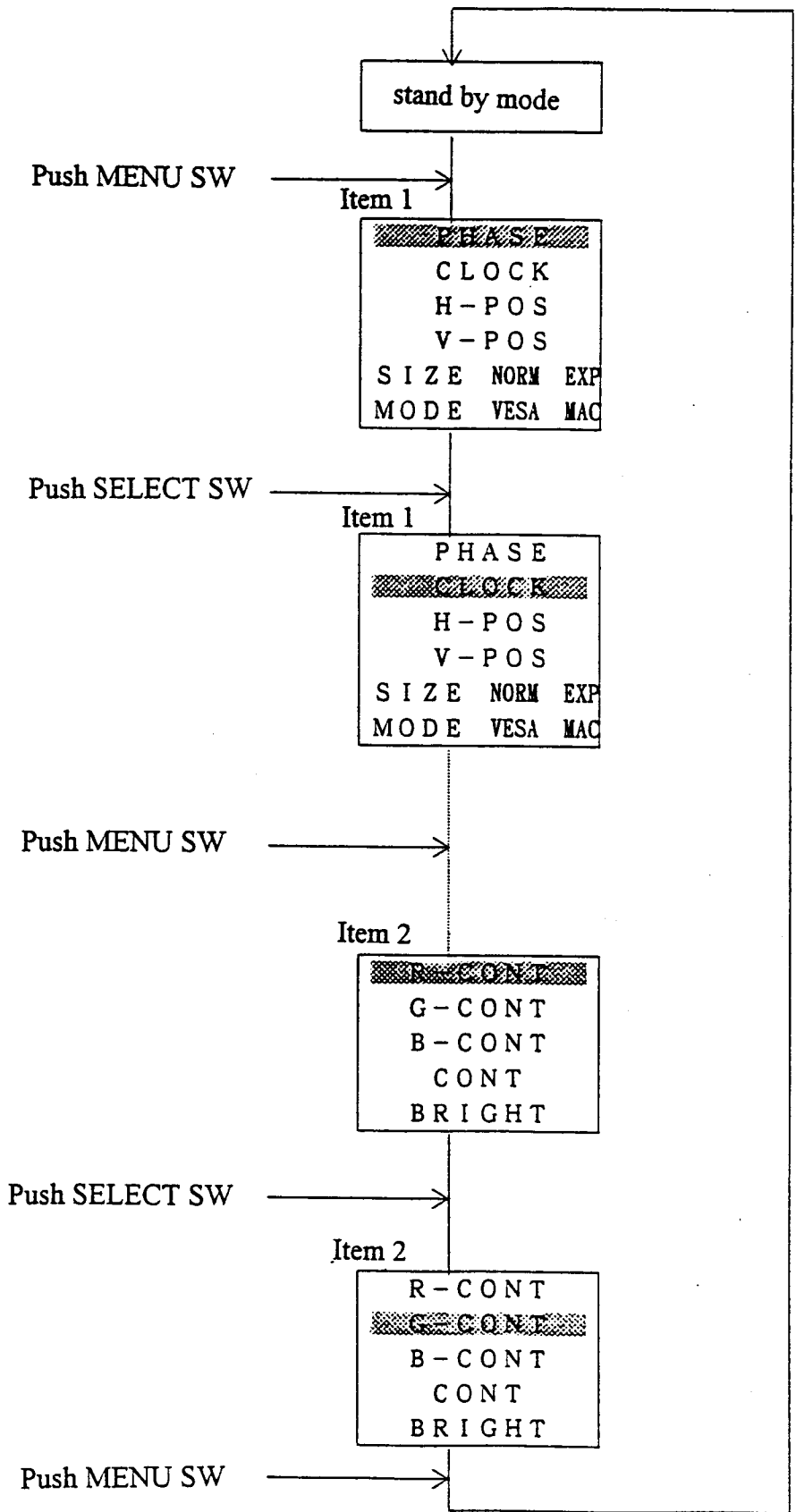
The setting switches are normally at stand-by. To let the setting effective by the condition, please push the MENU. Then, the above adjustable items 1 is displayed.

Then, you can select the setting items by the SELECT switch. You can change the setting values by the UP and the DOWN switches.

When no operation is done for the switches around 20 sec, it goes back to the stand-by mode and no more switching is accepted. except MENU to restart the setting.

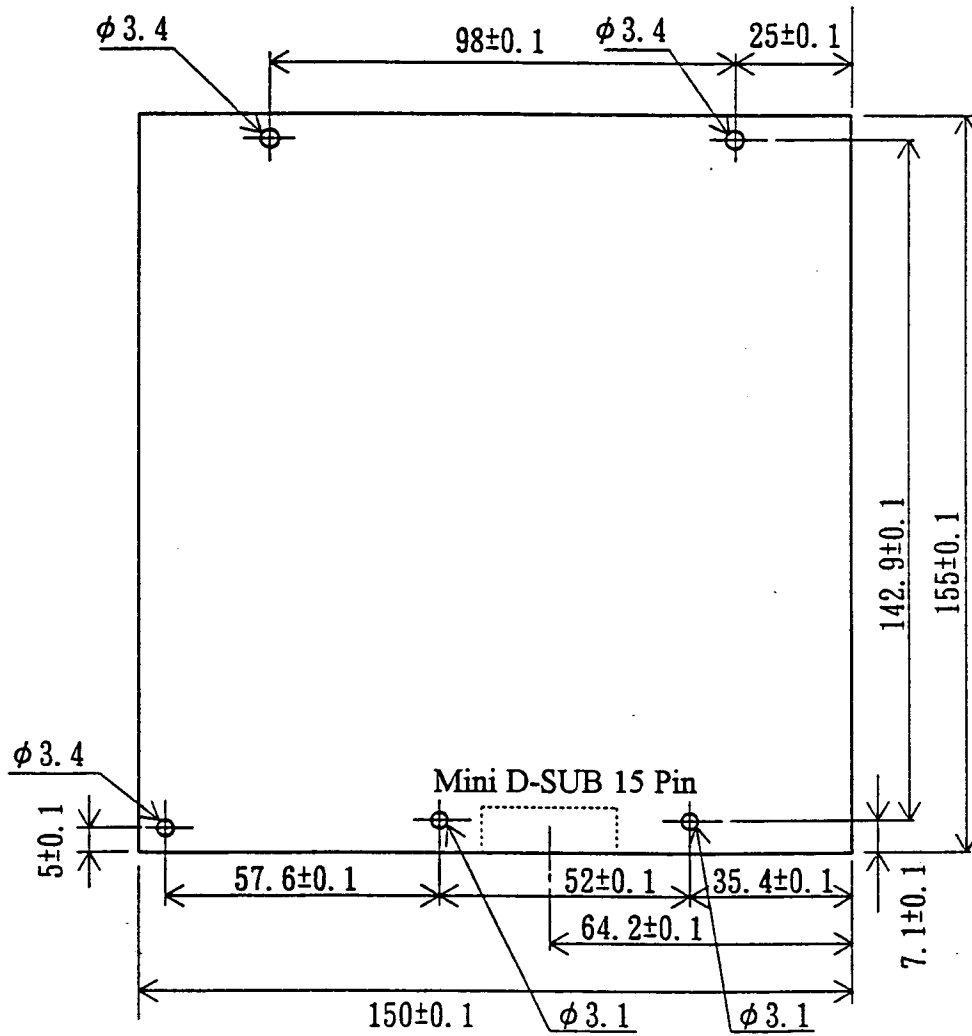
When you Power-On pushing both of the MENU and the SELECT switches, all the items go back to the original settings.

Adjustment Procedure Example



When no operation is done for the switches around 20 sec,
it goes back to the stand by mode.

11. PWB Mounting Hole Locations:



Unit [mm]

12. Notes for PWB Unit Treatment:

12-1. Please always Power-Off the unit before plug-in/plug-out any connectors and/or cables for input/output terminals.

12-2. Others:

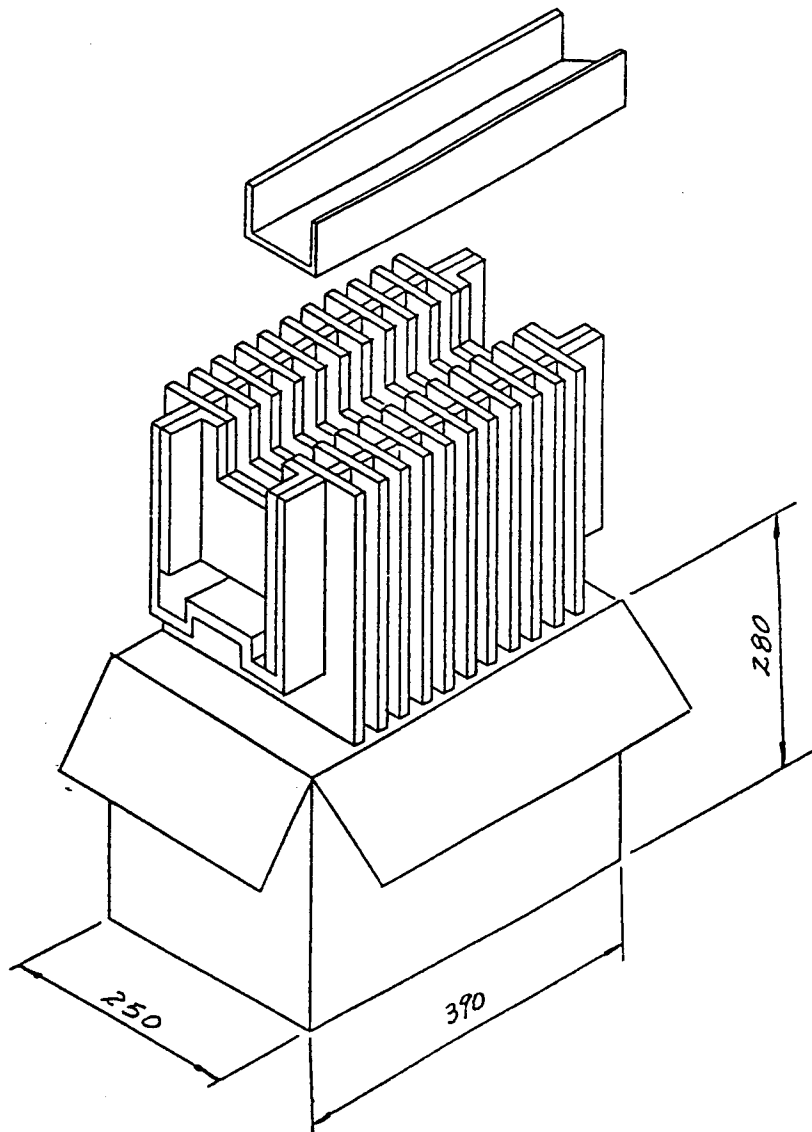
- a) Please do not add any stress on the I/F unit such as bending and twisting when you fix the I/F unit on your system.
- b) Since CMOS LSIs are used in the I/F unit, please be careful for ESD by using GND for operator, etc.
- c) Please keep commonly known warnings for electronic components.
- d) The other models of Sharp's LCD modules may have the different signal input timings from the LQ14X03. When you use the I/F unit for the other models, please carefully check the specification.
- e) Please consider the environment(temperature) of I/F unit.

13. Shipping Form:

13-1. Delivery Form

Package Quantity	10 pcs. / carton
Gross Weight	3.5 kg
Carton Size	250(W), 280(H), 390(D)
Piling Number of Cartons	MAX 10

13-2. Layout



(Unit mm)

I/F, Interface Board, NLRC01