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# **LQ10D421**

## **TFT-LCD Module**

Spec. Issue Date: June 30, 2000

No: LD-12610B

PREPARED BY :    DATE	<h1>SHARP</h1> <p>AVC LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <h2>SPECIFICATION</h2>	SPEC No. LD-12610B
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DEVICE SPECIFICATION FOR

# TFT-LCD Module

MODEL No.

## LQ10D421

**These parts have corresponded with the RoHS directive.**

CUSTOMER'S APPROVAL

DATE \_\_\_\_\_

BY \_\_\_\_\_

PRESENTED  
BY *T. Naka*

T. NAKA  
Division deputy general manager of  
Mobile LCD design center I  
ENGINEERING DEPARTMENT IV  
MOBILE LCD DESIGN CENTER I  
MOBILE LIQUID CRYSTAL DISPLAY GROUP  
SHARP CORPORATION

## 1. Application

This specification applies to color TFT-LCD module, LQ10D421

(This specification is only applied for the module which has letter "A" at the end of the lot number of the module.)

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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 .

## 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 640 × 3 × 480 dots panel with 262,144 colors by supplying 18 bit data signal (6bit/color), four timing signals,+3.3V/ +5V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The TFT-LCD panel used for this module is a low-reflection and higher-color-saturation type. Therefore, this module is also suitable for the multimedia use.

Optimum viewing direction is 6 o'clock.

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

## 3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	26 (10.4") Diagonal	cm
Active area	211.2(H) × 158.4(V)	mm
Pixel format	640(H) × 480(V)	pixel
	(1 pixel = R + G + B dots)	
Pixel pitch	0.330(H) × 0.330(V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	265.0(W) × 195.0(H) × 11.5max(D)	mm
Mass	620(max)	g
Surface treatment	Clear and hard-coating 3H	

\*1.Note: excluding backlight cables.

Outline dimensions is shown in Fig.1



【Note3】 【Note4】



R / L = High、U / D = Low

R / L = Low、U / D = Low



R / L = High、U / D = High

R / L = Low、U / D = High

4-2. Backlight driving

Used connector : BHR-03VS-1(JST)

CN2、CN3

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

Pin no.	Symbol	Function
1	V <sub>HIGH</sub>	Power supply for lamp (High voltage side)
2	NC	This is electrically opened.
3	V <sub>LOW</sub>	Power supply for lamp (Low voltage side)

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage	V <sub>I</sub>	Ta=25	- 0.3 ~ V <sub>CC</sub> + 0.3	V	【Note1】
+5V supply voltage	V <sub>CC</sub>	Ta=25	0 ~ + 6	V	
Storage temperature	T <sub>stg</sub>	-	- 30 ~ + 70		【Note2】
Operating temperature (Ambient)	Topa	-	- 10 ~ + 65		

【Note1】 CK,R0 ~ R5,G0 ~ G5,B0 ~ B5,Hsync,Vsync,ENAB, R/L, U/L

【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

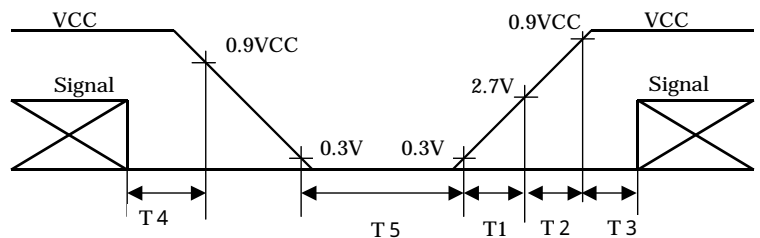
Ta = 25

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply	Supply voltage	Vcc	+3.0	+3.3   +5.0	+5.5	V	【Note1】
	Current dissipation	Icc	-	180	270	mA	Vcc=3.3V 【Note2】
Icc		-	150	230	mA	Vcc=5.0V 【Note2】	
Permissible input ripple voltage		V <sub>RF</sub>	-	-	100	mVp-p	
Input voltage (Low)		V <sub>IL</sub>	-	-	0.3V <sub>cc</sub>	V	【Note3】
Input voltage (High)		V <sub>IH</sub>	0.7V <sub>cc</sub>	-	-	V	
Input current (low)		I <sub>OL1</sub>	-	-	1.0	μA	V <sub>I</sub> =0V 【Note4】
		I <sub>OL2</sub>			10	μA	V <sub>I</sub> =0V 【Note5】
		I <sub>OL3</sub>	-	-	800	μA	V <sub>I</sub> =0V 【Note6】
Input current (High)		I <sub>OH1</sub>	-	-	1.0	μA	V <sub>I</sub> =V <sub>cc</sub> 【Note7】
		I <sub>OH2</sub>			300	μA	V <sub>I</sub> =V <sub>cc</sub> 【Note8】
		I <sub>OH3</sub>	-	-	800	μA	V <sub>I</sub> =V <sub>cc</sub> 【Note9】

【NOTE 1】

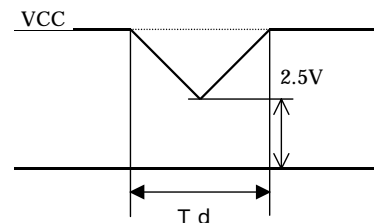
Vcc-turn-on conditions

- 0 < T1 15ms
- 0 < T2 10ms
- 0 < T3 100ms
- 0 < T4 1s
- T5 > 200ms



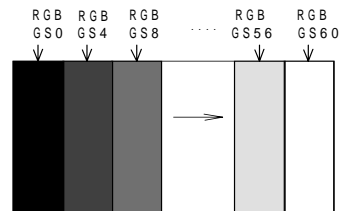
Vcc-dip conditions

- 1) 2.5V Vcc
  - td 10ms
  - 2) Vcc < 2.5V
- Vcc-dip condition should also follow  
The Vcc-turn-on conditions



【Note2】 Typical current situation : 16-gray-bar pattern.

480 line mode/Vcc=+3.3V/ + 5.0V



【Note3】 CK,R0~R5,G0~G5,B0~B5,Hsync,Vsync,ENAB,  
R/L,U/D

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

【Note5】 U/D,ENAB

【Note6】 R/L

【Note7】 CK,R0~R5,G0~G5,B0~B5,Hsnc,Vsync,R/L

【Note8】 ENAB

【Note9】 U/D

## 6-2. Backlight driving

The backlight system is an edge-lighting type with double CCFT (Cold Cathode Fluorescent Tube).

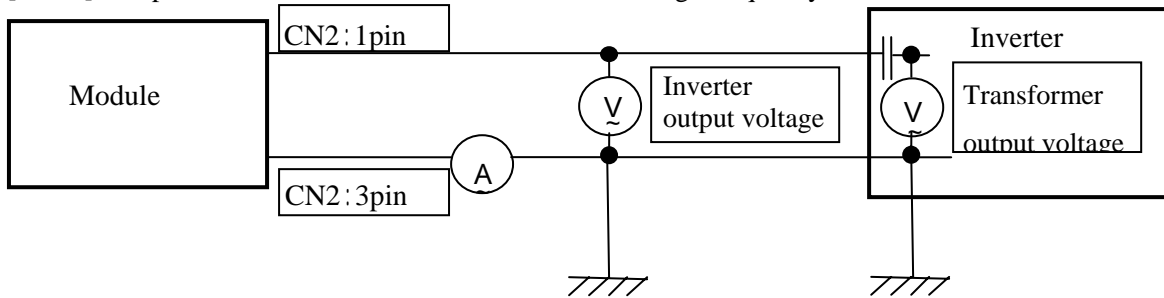
The characteristics of single lamp are shown in the following table.

(It is usually required to measure under the following condition.

condition:  $I_L=6.0\text{mA}$ ,  $T_a=25 \pm 2$ ,  $f_L=60\text{kHz}$ .)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current	$I_L$	2.0	6.0	6.5	mA rms	[Note1]
Lamp power consumption	PL	-	2.8	-	W	[Note2]
Lamp frequency	FL	20	35	60	kHz	[Note3]
Kick-off voltage	$V_s$	-	-	950	V rms	Inverter output
		-	-	1500		(Transformer output)
Lamp life time	LL	50000	-	-	Hour	[Note4] [Note5] $T_a=-10^\circ\text{C}$

[Note1] Lamp current is measured with current meter for high frequency as shown below.



[Note2] Referential data per one CCFT by calculation. ( $I_L \times V_L$ )

The data don't include loss at inverter. ( $I_L=6.0\text{mA rms}$ )

[Note3] Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

[Note4] The open output voltage of the inverter shall be maintained for more than 1s; otherwise the lamp may not be turned on.

[Note5] Above value is applicable when lamp (the long side of LCD module) is placed horizontally. (Landscape position)

Lamp life time is defined that it applied either or under this condition  
(Continuous turning on at  $T_a=25^\circ\text{C}$ ,  $I_L=6.0\text{mA rms}$ )

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

Kick-off voltage at  $T_a=-10^\circ\text{C}$  exceeds maximum value, 1500Vrms.

(Lamp lifetime may vary if lamp is in portrait position due to the change of mercury density inside the lamp.)

In case of operating under lower temp environment, the lamp exhaustion is accelerated and the brightness becomes lower.

(Continuous operating for around 1 month under lower temp condition may reduce the brightness to half of the original brightness.)

In case of such usage under lower temp environment, periodical lamp exchange is recommended.

[Note6] The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. when you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Be sure to use a back light power supply with the safety protection circuit such as the detection circuit for the excess voltage, excess current and or electric discharge waveform.

Be sure to use the detect circuit by which one side of the CCFT lamps can be controlled independently. Otherwise, when one side of the CCFT is open, the excess current may possibly be applied to the other side of the lamp.

[Note7] It is required to have the inverter designed so that to allow the impedance deviation of the two CCFT lamps and the capacity deviation of barast capacitor.

[Note8] Under the environment of 10lx or less, miss-lighting delay may occur.

## 7. Timing Characteristics of input signals

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

### 7-1. Timing characteristics

Parameter	Symbol	Mode	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	all	-	25.18	28.33	MHz
	High time	Tch	"	5	-	-	ns
	Low time	Tcl	"	10	-	-	ns
Data	Setup time	Tds	"	5	-	-	ns
	Hold time	Tdh	"	10	-	-	ns
Horizontal sync. signal	Cycle	TH	"	30.00	31.78	-	μs
			"	750	800	900	clock
	Pulse width	THp	"	2	96	200	clock
Vertical sync. signal	Cycle	TV	480	515	525	560	line
			400	446	449	480	line
			350	447	449	510	line
	Pulsewidth	TVp	all	1	-	34	line
Horizontal display period	THd	"	640	640	640	clock	
Hsync-Clock phase difference	THc	"	10	-	Tc-10	ns	
Hsync-Vsync phase difference	TVh	"	0	-	TH-THp	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	640	640	clock
Hsync-Enable signal phase difference	THe	44	-	TH-664	clock	

Note) When ENAB is fixed "Low", the display starts from the data of C104(clock) as shown

in Fig.2- ~ . Be careful that the module does not work when ENAB is fixed "High".

When the phase difference is below 104 clock, keep the "High level of ENAB is signal longer Than 104-The. If it will not be kept, the display starts from the data of C104(clock).

7-3. Vertical display position

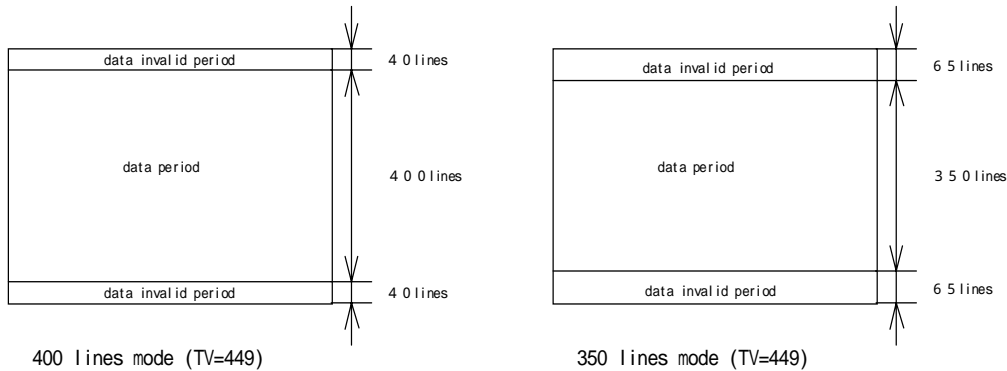
The vertical display position is automatically centered in the active area at each mode of VGA ,480-,400-,and 350-line mode . Each mode is selected depending on the polarity of the synchronous signals described in 4-1(Note1).

In each mode ,the data of TVn is displayed at the top line of the active area. And the display position will be centered on the screen like the following figure when the period of vertical synchronous signal,TV,is typical value.

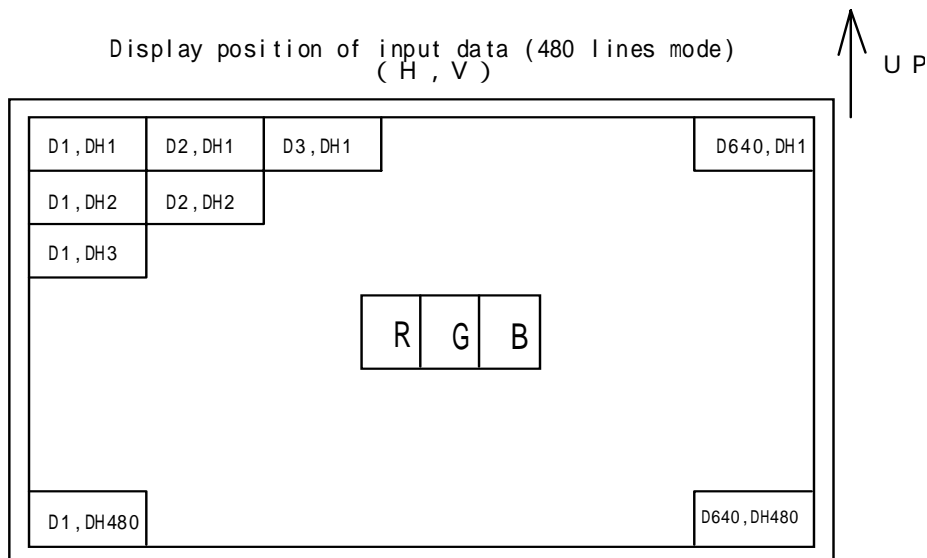
In 400-,and 350-line mode,the data in the vertical data invalid period is also displayed, So ,inputting all data "0" is recommended during vertical data invalid period.

ENAB signal has no relation to the vertical display position.

Mode	V-data start(TVs)	V-data period(TVd)	V-display start(TVn)	V-display period	Unit	Remark
480	34	480	34	480	line	
400	34	400	443-TV	480	line	
350	61	350	445-TV	480	line	



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



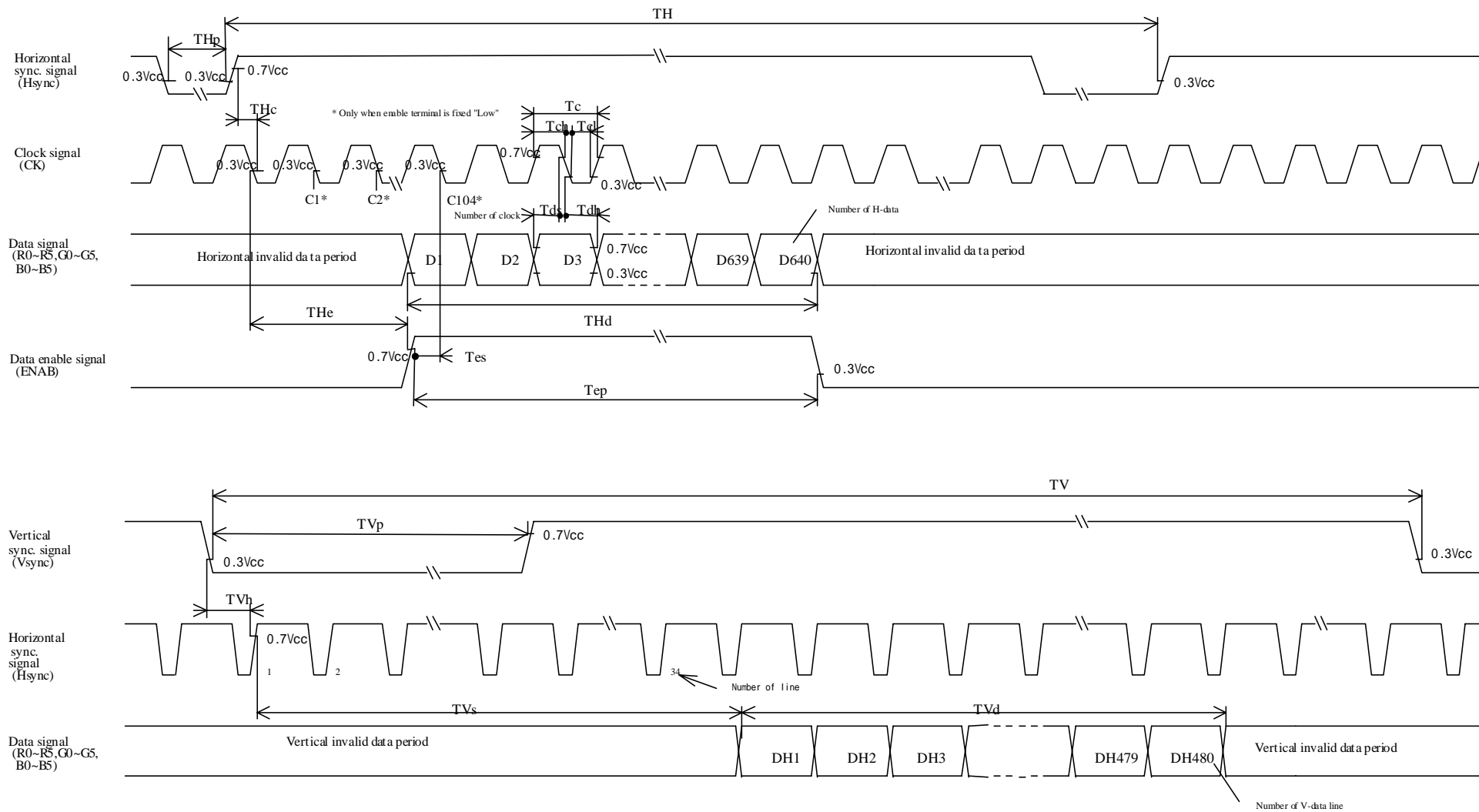


Fig 2-1 Input signal waveforms (480 line mode)

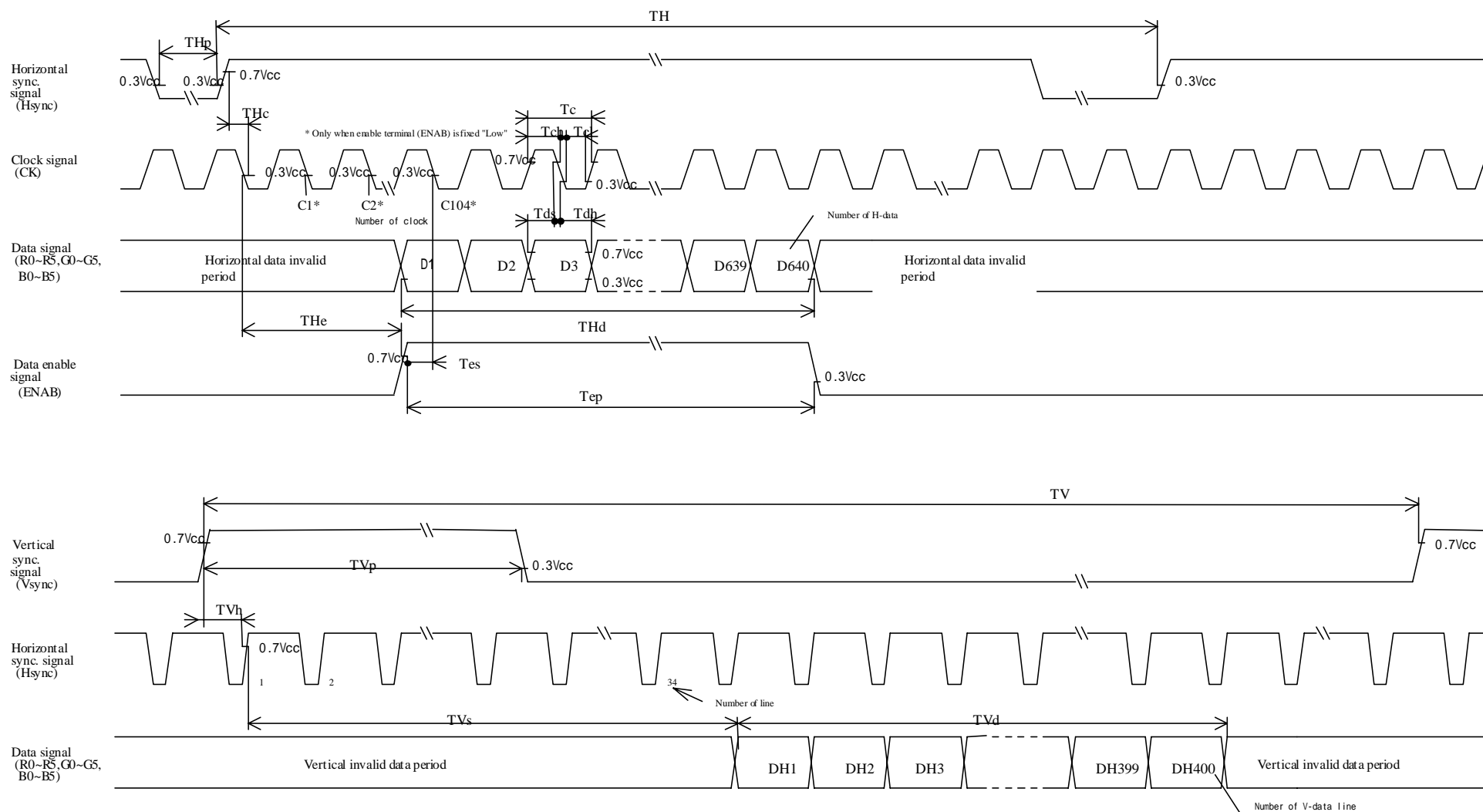


Fig.2-2 Input signal waveforms (400 line mode)

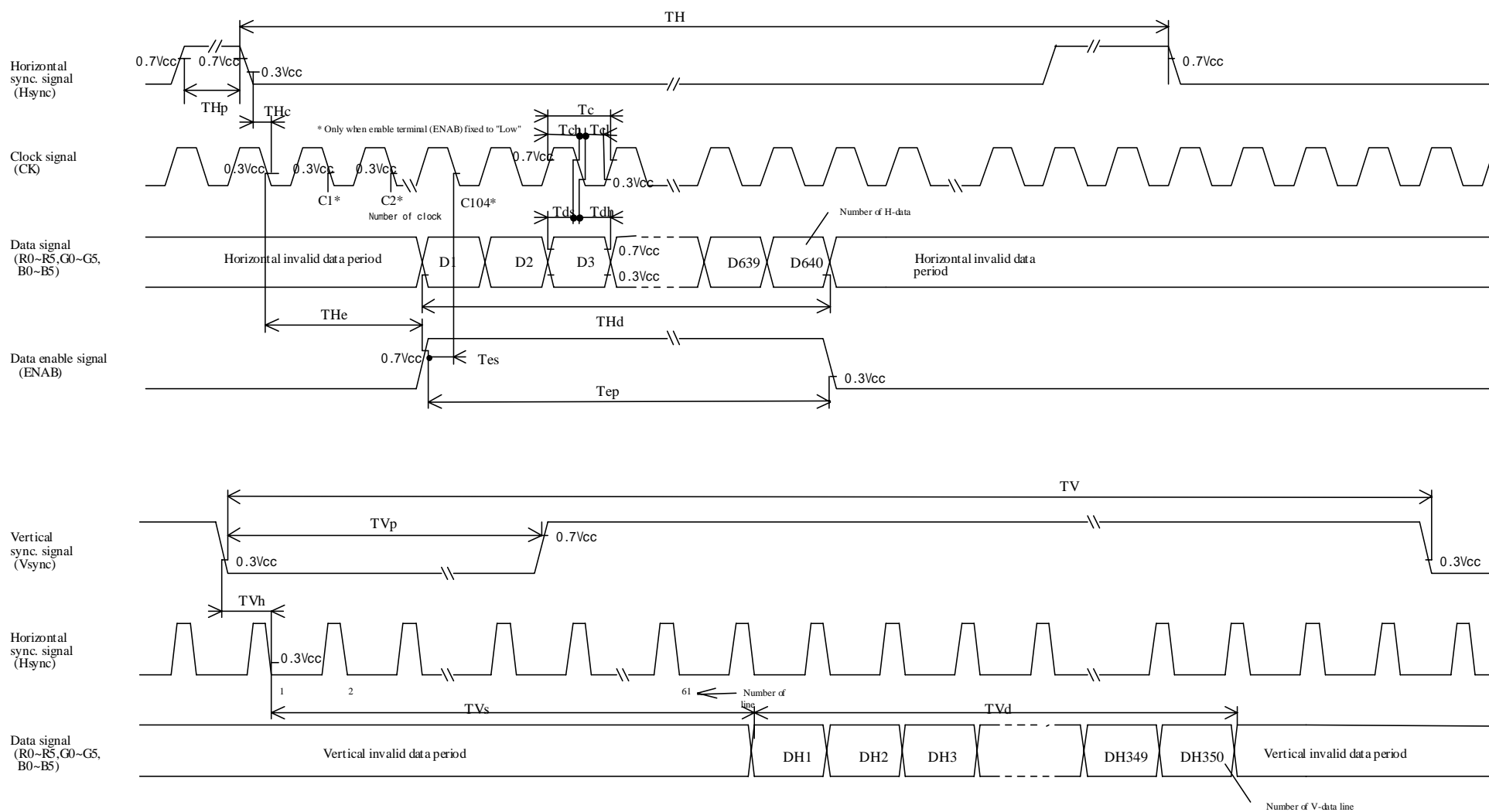


Fig.2-3 Input signal waveforms (350 line mode)

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

	Colors & Gray scale	Data signal																		
		Gray Scale	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
<b>Basic Color</b>	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
<b>Gray Scale of Red</b>	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
<b>Gray Scale of Green</b>	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
<b>Gray Scale of Blue</b>	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=+5V

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle Range	Horizontal	21, 22	C R > 1 0	60	70	-	Deg.	【Note1,4】
	Vertical	11		35	40	-	Deg.	
		12		55	70	-	Deg.	
Contrast ratio		C R	= 0 °	150	-	-	-	【Note2,4】
			Optimum Viewing Angle	-	300	-	-	
Response Time	Rise	r	= 0 °	-	20	-	ms	【Note3,4】
	Decay	d		-	40	-	ms	
Chromaticity of White		x	= 0 °	-	0.305	-		【Note4】 I <sub>L</sub> =6.0mA <sub>rms</sub>
		y		-	0.329	-		
Luminance of white		Y <sub>L</sub>		240	300	-	cd/m <sup>2</sup>	f=35kHz
White Uniformity		w		-	-	1.45	-	【Note5】

The measurement shall be executed 30 minutes after lighting at rating. (condition:I<sub>L</sub>=6.0mA<sub>rms</sub>)

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

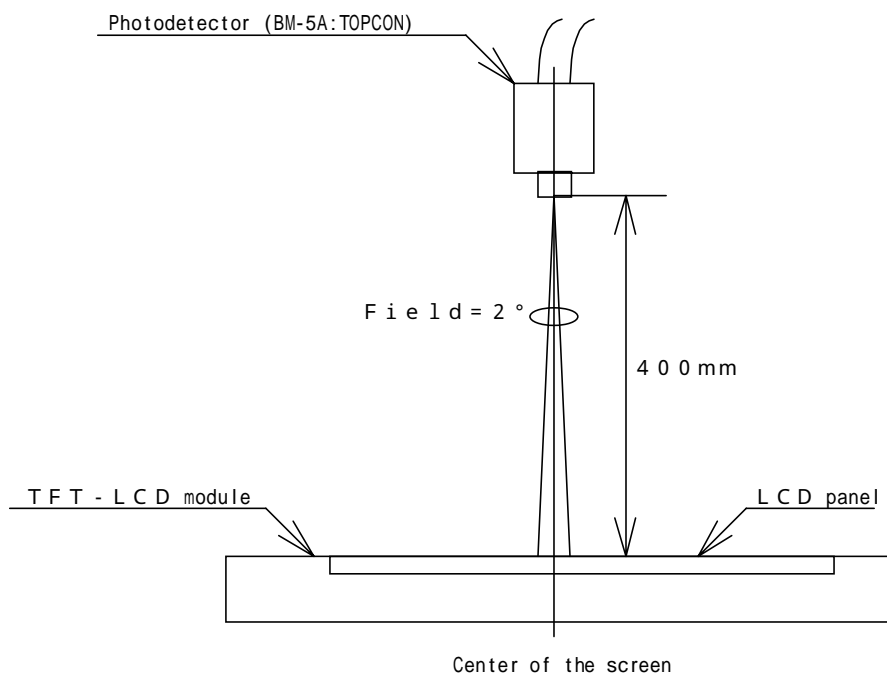
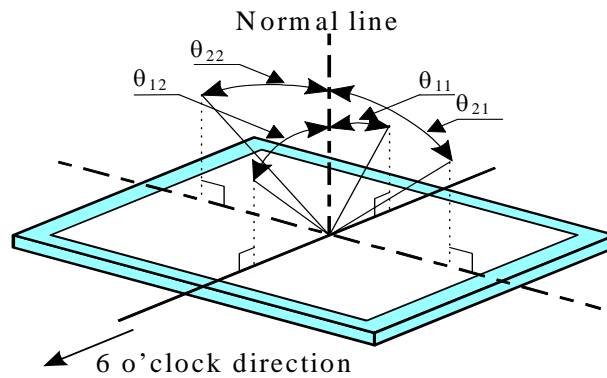


Fig.3 Optical characteristics measurement method

【Note1】 Definitions of viewing angle range:



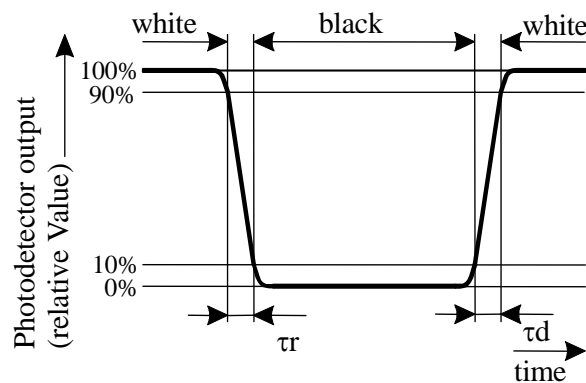
【Note2】 Definition of contrast ratio:

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:

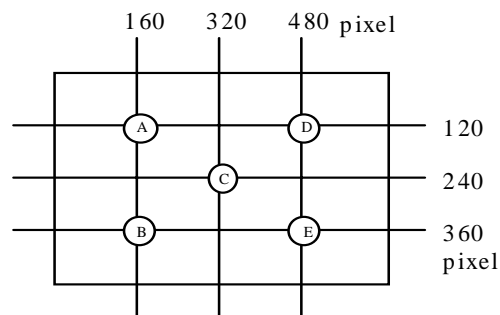
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



【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).



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

## 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. Observe all other precautionary requirements in handling electric components.
- h) Protection 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.  
Blow off 'dust' on the polarizer by using an ionized nitrogen.
- i) In case of attaching protective board over the LCD, be careful about the optical interface fringe etc. which degrades display quality.
- j) Do not expose the LCD panel to direct sunlight. Lightproof shade etc. should be attached when LCD panel is used under such environment.
- k) Connect GND to 4 place of mounting holes to stabilize against EMI and external noise.
- l) There are high voltage portions on the backlight and very dangerous. Careless touch may lead to electrical shock. When exchange lamps or service, turn off the power without tail.
- m) 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.
- n) Cold cathode fluorescent lamp in LCD panel contains a small amount of mercury, please follow local ordinances or regulations for disposal.
- o) Be sure not to apply tensile stress to the lamp lead cable.
- p) Do not expose the LCD panel to direct sunlight. Lightproof shade etc. should be attached when LCD panel is used under such environment.
- q) Be careful of a back light lead not to pull by force at the time of the wiring to an inverter, or line processing.
- r) When install LCD modules in the cabinet, recommended torque value is “ $0.294 \pm 0.02\text{N} \cdot \text{m}$  ( $3.0 \pm 0.2\text{kgf} \cdot \text{cm}$ )”.  
Be sure to confirm it in the same condition as it is installed in your instrument.
- s) Liquid crystal contained in the panel may leak if the LCD is broken. Rinse it as soon as possible if it gets inside your eye or mouth by mistake.
- t) Notice: Never dismantle the module , because it will cause failure.
- u) Be careful when using it for long time with fixed pattern display as it may cause afterimage.
- v) 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.
- w) 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.

## 12. Packing form

Product country	JAPAN
Piling number of cartons	7 ( Max )
Packing quantity in one carton	20
Carton size [mm]	525 (W)×309(D)×377(H)
Total mass of one carton filled with full modules	17.5kg
Packing form is shown	Fig.4



## 5. Exchange of Lamps

Lamps for LCD module can be worn out, so please replace them to new lamps when needed in accordance with the following ①~③ procedure.

- ① The latch for holder can be loosened by pushing the black color click portion with small minus shaped screw driver. The click is located at the side of the holder.

Loosening the latch, draw the lamp holder the "B" direction.

(refer to the figure 4 and figure 5)

- ② The new lamp holder as spare parts should be distinguished between up side and bottom and bottom side and upper side one has a marking of "▽" at the side of holder.

And also module side has the same marking at the upper side of the module. Please take care the marking direction in accordance with following figure.

Insert both lamp holders to direction "C" and confirm it inserted completely with click.

(refer to the figure 5)

- ③ Not only one side, both lamps should be exchanged.

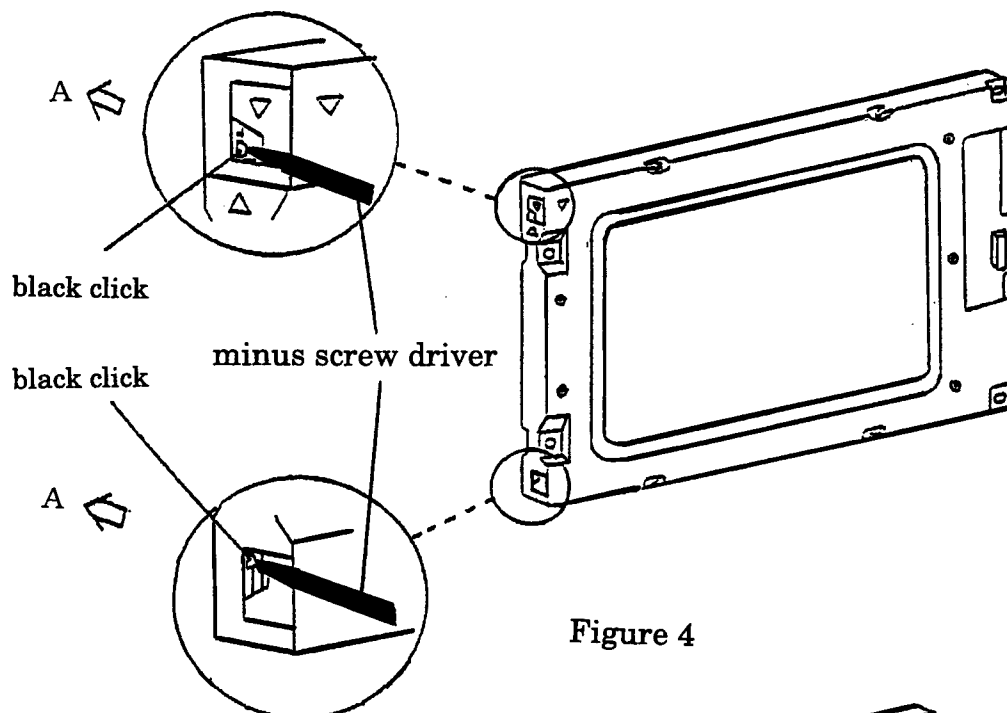


Figure 4

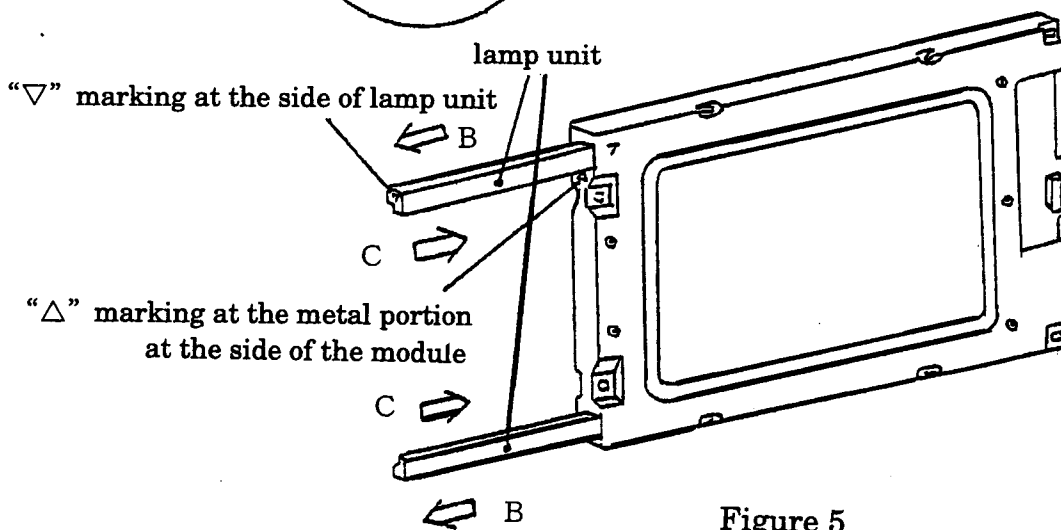


Figure 5

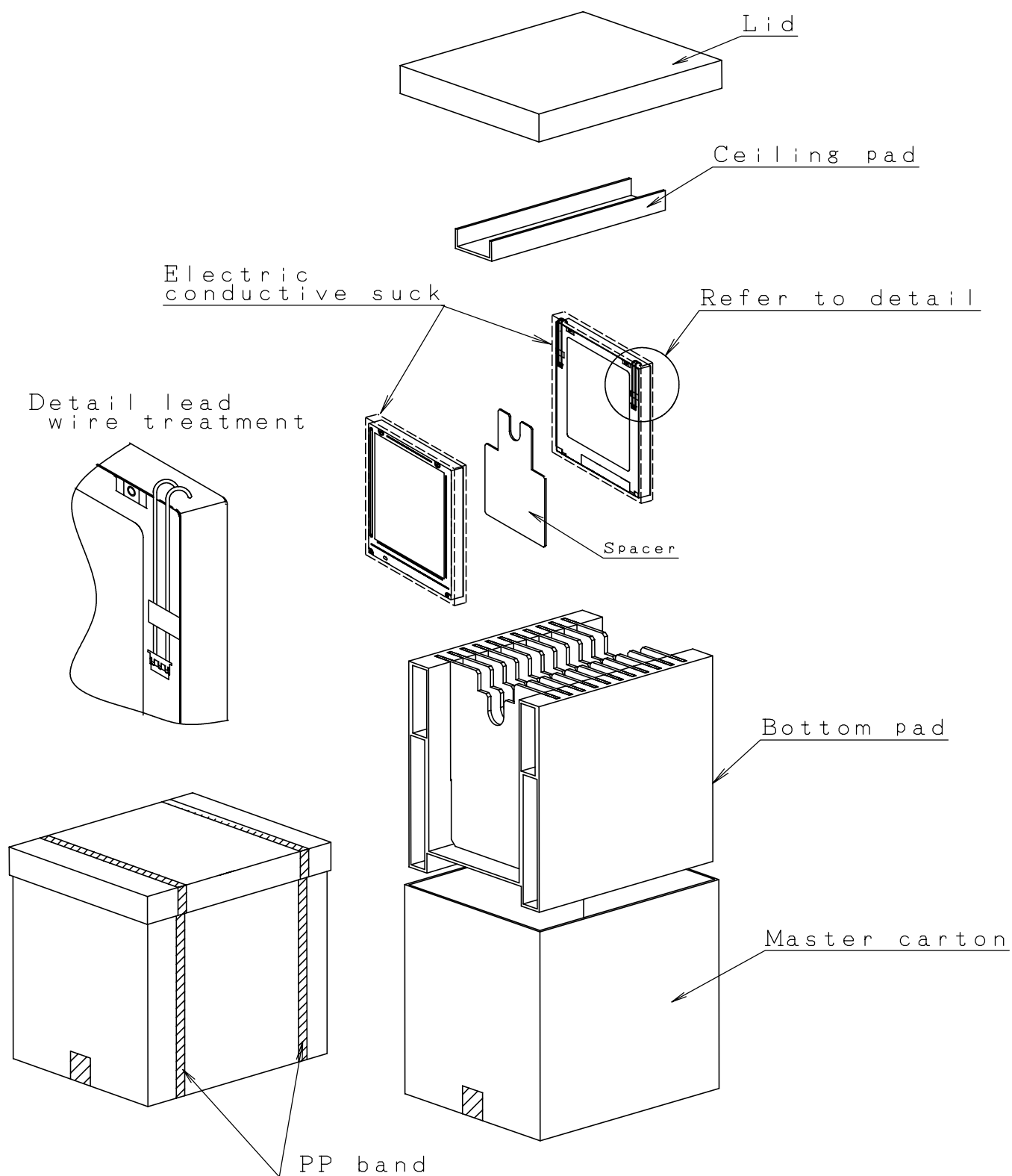


Fig.4 Packing Form

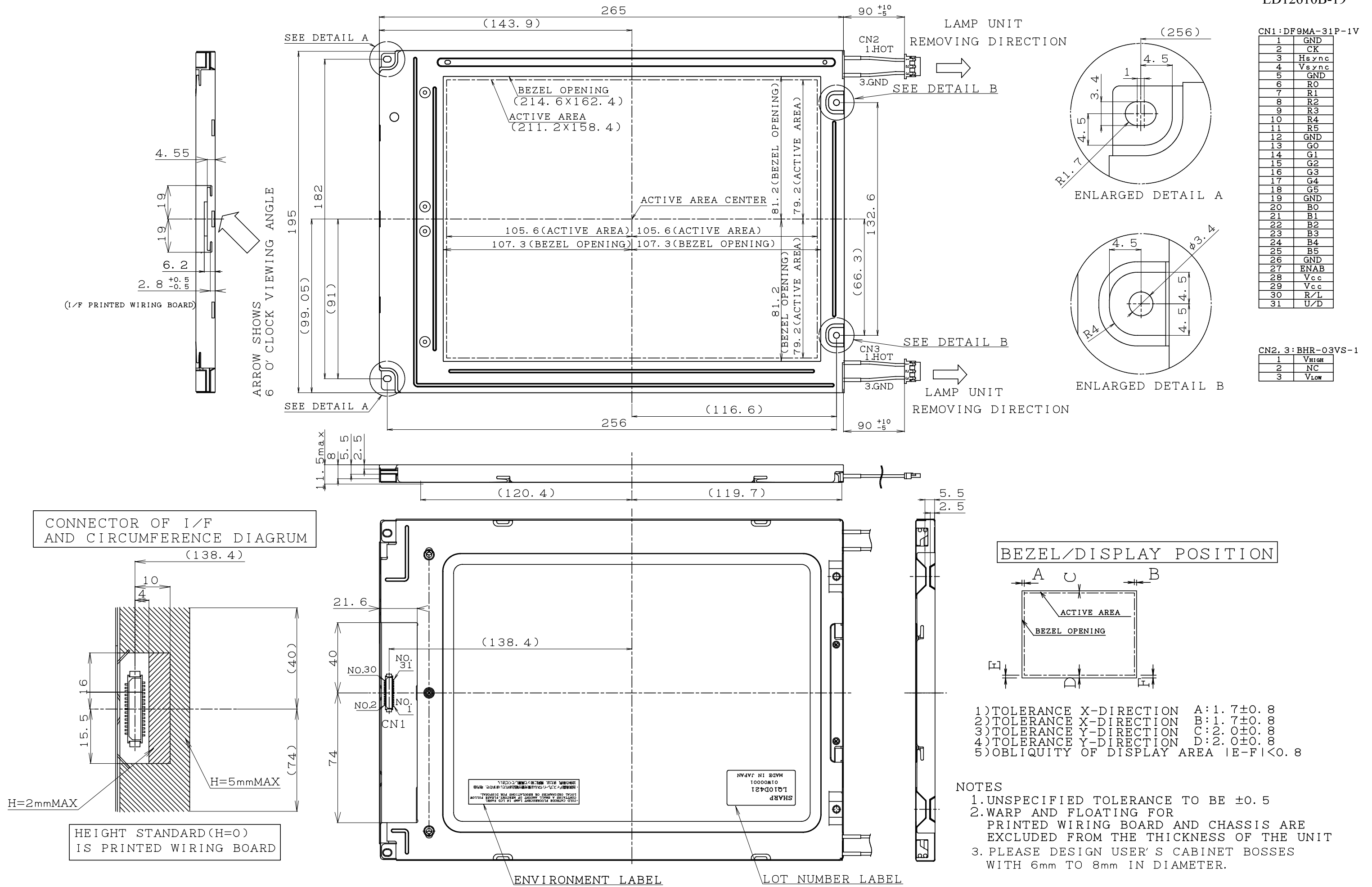


Fig.1 LQ10D421 Outline Dimensions

**SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.**

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# SHARP®

## **NORTH AMERICA**

---

SHARP Microelectronics of the Americas  
5700 NW Pacific Rim Blvd.  
Camas, WA 98607, U.S.A.  
Phone: (1) 360-834-2500  
Fax: (1) 360-834-8903  
Fast Info: (1) 800-833-9437  
www.sharpsma.com

## **EUROPE**

---

SHARP Microelectronics Europe  
Division of Sharp Electronics (Europe) GmbH  
Sonninstrasse 3  
20097 Hamburg, Germany  
Phone: (49) 40-2376-2286  
Fax: (49) 40-2376-2232  
www.sharpsme.com

## **JAPAN**

---

SHARP Corporation  
Electronic Components & Devices  
22-22 Nagaike-cho, Abeno-Ku  
Osaka 545-8522, Japan  
Phone: (81) 6-6621-1221  
Fax: (81) 6117-725300/6117-725301  
www.sharp-world.com

## **TAIWAN**

---

SHARP Electronic Components  
(Taiwan) Corporation  
8F-A, No. 16, Sec. 4, Nanking E. Rd.  
Taipei, Taiwan, Republic of China  
Phone: (886) 2-2577-7341  
Fax: (886) 2-2577-7326/2-2577-7328

## **SINGAPORE**

---

SHARP Electronics (Singapore) PTE., Ltd.  
438A, Alexandra Road, #05-01/02  
Alexandra Technopark,  
Singapore 119967  
Phone: (65) 271-3566  
Fax: (65) 271-3855

## **KOREA**

---

SHARP Electronic Components  
(Korea) Corporation  
RM 501 Geosung B/D, 541  
Dohwa-dong, Mapo-ku  
Seoul 121-701, Korea  
Phone: (82) 2-711-5813 ~ 8  
Fax: (82) 2-711-5819

## **CHINA**

---

SHARP Microelectronics of China  
(Shanghai) Co., Ltd.  
28 Xin Jin Qiao Road King Tower 16F  
Pudong Shanghai, 201206 P.R. China  
Phone: (86) 21-5854-7710/21-5834-6056  
Fax: (86) 21-5854-4340/21-5834-6057

### **Head Office:**

No. 360, Bashen Road,  
Xin Development Bldg. 22  
Waigaoqiao Free Trade Zone Shanghai  
200131 P.R. China  
Email: smc@china.global.sharp.co.jp

## **HONG KONG**

---

SHARP-ROXY (Hong Kong) Ltd.  
3rd Business Division,  
17/F, Admiralty Centre, Tower 1  
18 Harcourt Road, Hong Kong  
Phone: (852) 28229311  
Fax: (852) 28660779  
www.sharp.com.hk

### **Shenzhen Representative Office:**

Room 13B1, Tower C,  
Electronics Science & Technology Building  
Shen Nan Zhong Road  
Shenzhen, P.R. China  
Phone: (86) 755-3273731  
Fax: (86) 755-3273735