



ENH150X1-200/300 Color TFT-LCD Module Features

GENERAL DESCRIPTION

Panelview provides optically enhanced solutions to the standard Sharp LQ150X1DG16 color active matrix LCD module. The first enhancement is an index matching (IM) film lamination to the front surface of the display polarizer. The IM film is available in two surface treatments - IM/Clear and IM/110 (a 10% diffusion). The second enhancement is the incorporation of a reflective polarizer (RP) to improve brightness by up to 40%.

The module is composed of a color TFT-LCD panel, driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and text can be displayed on a 1024x3x768 dot panel with 262,144 colors by supplying 36 bit data signals (6bit x 2 pixel x RGB), four timing signals, +5V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

It is a wide viewing-angle-module (Vertical viewing angle: 120° Horizontal viewing angle: 140°).

Input signal timing conforms with 75Hz mode of VESA standard.

Panelview 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. Panelview does assume the responsibility for the warranty of the enhanced product.

MECHANICAL SPECIFICATIONS

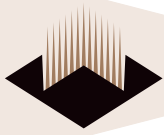
Parameter	Specifications	Units
Display Size	38 (Diagonal)	cm
	15.0 (Diagonal)	inch
Active Area	304.1(H) x 228.1(V)	mm
Pixel Format	1024(H) x 768(V)	pixel
	(1 pixel=R+G+B dots)	—
Pixel Pitch	0.297(H) X 0.297(V)	mm
Pixel Configuration	RGB vertical stripe	—
Display Mode	Normally white	—
Unit Outline Dimensions (1)	335(W)x257.9(H)x15.9(D)	mm
Mass	1400 (max.)	g
Surface Treatment	IM/Clear (glossy) or IM/110 and hardcoat 3H	—

Note:

1. Excludes backlight cables.

The thickness of module (D) does not contain the projection

2. Outline dimension shown in fig. 1



INPUT TEMINALS

TFT-LCD panel driving

CN1 The module-side connector :FX8-60S-SV (Hirose Electric Co., Ltd.)
 The user-side connector :FX8-60P-SV (Hirose Electric Co., Ltd.)

Pin No.	Symbol	Function
1	GND	GND
2	RB0	RED even data signal (LSB)
3	RB1	RED even data signal
4	RB2	RED even data signal
5	RB3	RED even data signal
6	RB4	RED even data signal
7	RB5	RED even data signal (MSB)
8	GND	GND
9	GB0	GREEN even data signal (LSB)
10	GB1	GREEN even data signal
11	GB2	GREEN even data signal
12	GB3	GREEN even data signal
13	GB4	GREEN even data signal
14	GB5	GREEN even data signal (MSB)
15	GND	GND
16	BB0	BLUE even data signal (LSB)
17	BB1	BLUE even data signal
18	BB2	BLUE even data signal
19	BB3	BLUE even data signal
20	BB4	BLUE even data signal
21	BB5	BLUE even data signal (MSB)
22	GND	GND
23	RA0	RED odd data signal (LSB)
24	RA1	RED odd data signal
25	RA2	RED odd data signal
26	RA3	RED odd data signal
27	RA4	RED odd data signal
28	RA5	RED odd data signal (MSB)
29	GND	GND
30	GA0	GREEN odd data signal (LSB)
31	GA1	GREEN odd data signal
32	GA2	GREEN odd data signal
33	GA3	GREEN odd data signal
34	GA4	GREEN odd data signal
35	GA5	GREEN odd data signal (MSB)
36	GND	GND
37	BA0	BLUE odd data signal (LSB)
38	BA1	BLUE odd data signal
39	BA2	BLUE odd data signal
40	BA3	BLUE odd data signal



continued

Pin No.	Symbol	Function
41	BA4	BLUE odd data signal
42	BA5	BLUE odd data signal (MSB)
43	GND	GND
44	GND	GND
45	GND	GND
46	Vsync	Vertical synchronous signal
47	Hsync	Horizontal synchronous signal
48	ENAB	Data enable signal (Signal to settle the display position) (1)
49	GND	GND
50	GND	GND
51	CKB	Clock B signal for sampling even data signal
52	CKA	Clock A signal for sampling odd data signal
53	GND	GND
54	GND	GND (Reserve)
55	GND	GND (Reserve)
56	MODE	Timing signal select (1)
57	Vcc	+5V power supply
58	Vcc	+5V power supply
59	Vcc	+5V power supply
60	Vcc	+5V power supply

Shielding case is connected with GND in the module.

Note 1) In case MODE is fixed "Low", the display start timing is determined by Vsync and ENAB.

The vertical display start position and horizontal display start position are determined as described on page 6. Do not keep ENAB "high" during operation.

In case MODE is fixed "High" or "Open", the display start timing is determined by only ENAB.

BACKLIGHT DRIVING

CN2,CN3 The module-side connector connector :BHR-03VS-1(JST)

The user-side connector :SM02(8.0)B-BHS-1(JST)

Pin no.	Symbol	Function
1	V _{HIGH}	Power supply for lamp (High voltage side)
2	NC	This is electronically opened
3	V _{LOW}	Power supply for lamp (Low voltage side)

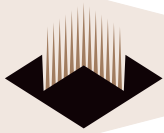
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Input Voltage (1)	V _I	Ta=25°C	-0.3 ~ +5.5	V
+5.0V Supply Voltage	V _{CC}	Ta=25°C	0 ~ +6	V
Storage Temperature (2)	T _{STG}	—	-25 ~ +60	°C
Operation Temperature (Ambient) (2)	T _{OPA}	—	0 ~ +50	°C

Note

1. CKA,CKB,RA0~RA5, GA0~GA5, BA0~BA5, RB0~RB5, GB0~GB5, BB0~BB5,Hsync, Vsync, ENAB,MODE

2. Humidity: 95%RH Max. (Ta ≤ 40°C). Maximum wet-bulb temperature at 39°C or less at (Ta>40°C). No condensation.



ELECTRICAL CHARACTERISTICS

TFT-LCD panel driving

Ta=25°C

Parameter		Symbol	Min.	Typ.	Max	Unit	Remark
Vcc	Supply Voltage	Vcc	+4.5	+5.0	+5.5	V	(1)
	Current dissipation	Icc	—	300	450	mA	(2)
Permissive input ripple voltage		V _{RF}	—	—	100	mVp-p	Vcc= +5.0V
Input voltage (Low)		V _{IL}	GND	—	0.6	V	(3)
Input voltage (High)		V _{IH}	2.6	—	Vcc	V	(3)
Input current (Low)		I _{IL}	—	—	10	μA	V _I =GND (3)
			—	—	400	μA	V _I =GND (4)
Input current (High)		I _{IH}	—	—	10	μA	V _I =Vcc (3)
			—	—	600	μA	V _I =Vcc (4)

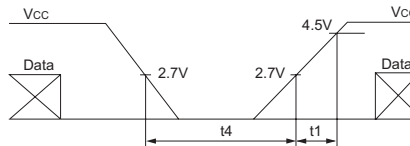
3.3(v) logic is recommended as input signals.

Notes:

1. On-off conditions for supply voltage

$$0 < t_1 \leq 10\text{ms}$$

$$t_4 \geq 1\text{s}$$



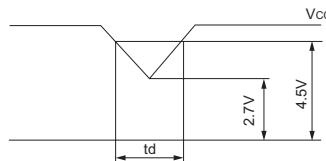
Vcc-dip conditions

1) $2.7\text{V} \leq V_{cc} < 4.5\text{V}$

$t_d \leq 10\text{ms}$

2) $V_{cc} < 2.7\text{V}$

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



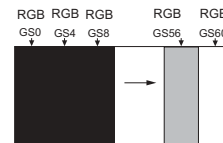
2. Typical current situation: 16-gray-bar pattern.

Vcc= +5.0V,

Gray scale : GS(4n)

n=0~15

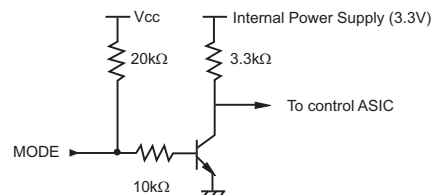
The explanation of each gray scale, GS(4n), is described on page 10.

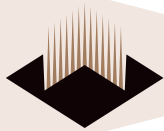


3. CKA,CKB, RA0~RA5, GA0~GA5, BA0~BA5, RB0~RB5, GB0~GB5, BB0~BB5, Hsync, Vsync, ENAB

4) MODE

Input circuit of MODE is shown in right figure.





BACKLIGHT DRIVING

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

The value mentioned below is at the case of one CCFT.

Parameter	Symbol	Min.	Typ.	Max	Unit	Remark
Lamp current range	I_L	2.5	6.0	6.5	mArms	(1)
Lamp voltage	V_L	—	690	—	Vrms	$T_a=25^{\circ}\text{C}$
Lamp power consumption	P_L	—	4.1	—	W	(2)
Lamp frequency	F_L	20	60	70	KHz	(3)
Kick-off voltage	V_s	—	—	850	Vrms	$T_a=25^{\circ}\text{C}$ (4)
		—	—	1450	Vrms	$T_a=0^{\circ}\text{C}$ (4)
Lamp life time	L_L	50000	—	—	hour	(5)

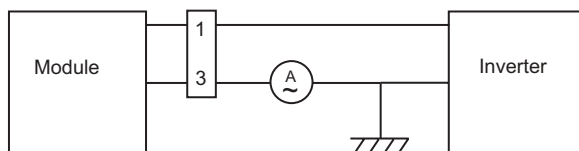
Notes:

1. A lamp can be lit in the range of the lamp current shown above.

Maximum rating for current is measured by high frequency current measurement equipment connected to V_{Low} at circuit shown below. (Note: To keep enough kick-off voltage and necessary steady voltage for CCFT.)

Lamp frequency: 20~60kHz

Ambient temperature: 0~50°C



* 3pin is V_{Low}

2. Referential data per one CCFT by calculation ($I_L \times V_L$).

The data does not include loss at inverter.

3. Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, adjust lamp frequency and keep inverter far from module or use electronic shielding between inverter and module to avoid interference.

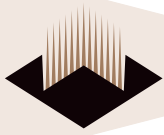
4. The voltage above this value should be applied to the lamp for more than 1 second to startup. Otherwise, the lamp may not turn on.

5. 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 $I_L = 6.0 \pm 0.5\text{mArms}$.

(1) Brightness becomes 50% of the original value under standard conditions.

(2) Kick-off voltage at $T_a=0^{\circ}\text{C}$ exceeds maximum value, 1450Vrms.

The performance of the backlight, for example life time or brightness, is influenced by the characteristics of the DC-AC inverter for the lamp. When designing or ordering the inverter, make sure that poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) do not occur. Once this is confirmed, the module should be operated in the same condition as it is installed in the instrument.



TIMING CHARACTERISTICS OF INPUT SIGNALS

H-V mode (MODE = "Low")

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

TIMING CHARACTERISTICS

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock A Clock B	Frequency	1/Tc	25	32.5	40	MHz
	High time	T _{CH}	9	—	—	ns
	Low time	T _{CL}	9	—	—	ns
	Duty ratio	T _{CH} /T _{CL}	0.67	1.00	1.50	—
Data	Setup time	T _{DS}	8	—	—	ns
	Hold time	T _{DH}	8	—	—	ns
Horizontal sync. signal	Cycle	TH	16.6	20.7	—	μs
			528	672	860	clock
	Pulse width	TH _P	2	68	—	clock
Horizontal display start		TH _{BP}	—	148	—	clock
Hsync-Clock phase difference		TFc	5	—	—	ns
Vertical sync. signal	Cycle	TV	—	16.7	—	ms (1)
			773	806	990	line
	Pulse width	TV _P	1	6	—	line
Vertical data start		TV _{BP}	35	35	35	line
Hsync-Vsync phase difference		TV _H	1	—	TH-TH _P	clock

Note 1): In case of lower frequency; the deterioration of display quality, flicker, etc. may occur.

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
Enable signal	Setup time	T _{ES}	8	—	Tc-10	ns
	Pulse width	T _{EP}	10	512	512	clock
Hsync-ENAB phase difference		TH _E	TH _P + 1	148	TH-512	clock

Do not keep ENAB "Low" during operation.

Vertical Display Position

The vertical display start position is the 35th line from the falling edge of Vsync. (Fig. 2).

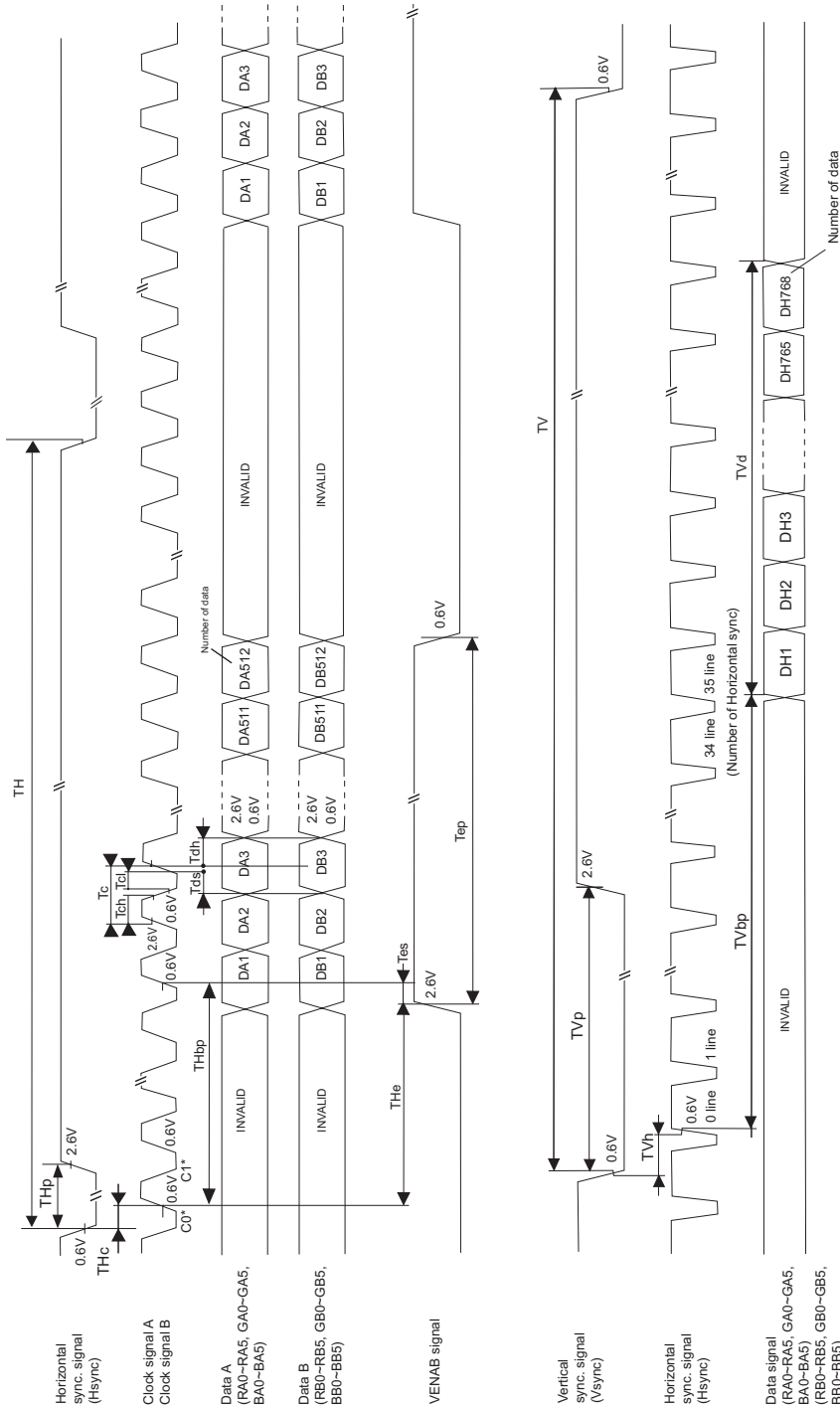
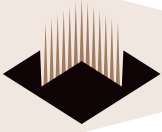
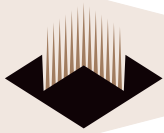


Fig 2 Input Signal Waveforms (H-V Mode)



ENAB mode (MODE = "High" or "Open")

Timing diagrams of input signal are shown in Fig. 3.

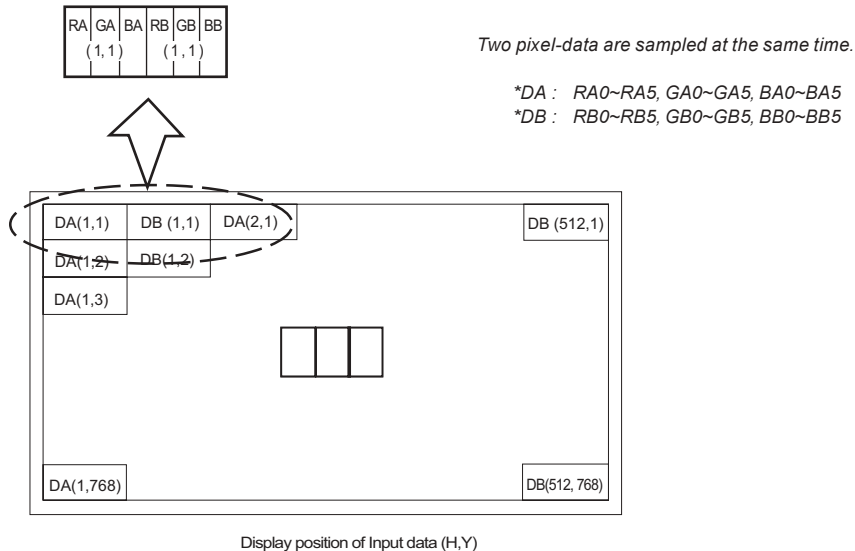
TIMING CHARACTERISTICS

	Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock A Clock B	Frequency	1/T _C	25	32.5	40	MHz
	High time	T _{CH}	9	—	—	ns
	Low time	T _{CL}	9	—	—	ns
	Duty ratio	T _{CH} /T _{CL}	0.67	1.00	1.50	—
Data	Set-up time	T _{DS}	8	—	—	ns
	Hold time	T _{DH}	8	—	—	ns
Data enable signal	Set-up time	T _{ES}	8	—	T _C -10	ns
	Horizontal period	TH	16.6	20.7	—	μs
			528	672	860	clock
	Horizontal period (high)	TH _P	10	512	512	clock
	Vertical period	TV	770	806	990	line
	Vertical blanking width	TV _B	2	38	222	line

Note: If using an extended vertical period, the deterioration of display quality, flicker, etc. may occur.

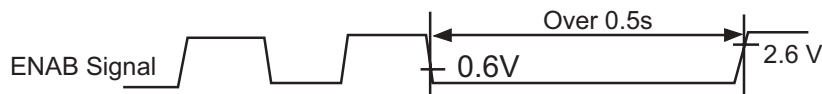
Input Data Signals and Display Position on the Screen

Graphics and text can be displayed at 1024 x 3 x 768 dots on a panel with 262,144 colors by supplying 36 bit data signal (6bit/color [64 gray scale] x 3 x 2 pixels).



Sleep Mode

This LCD module stops operation, and the picture of the LCD module becomes completely white, if ENAB signal stays "Low" for over 0.5 sec. Follow the above input signal timing for normal operation.



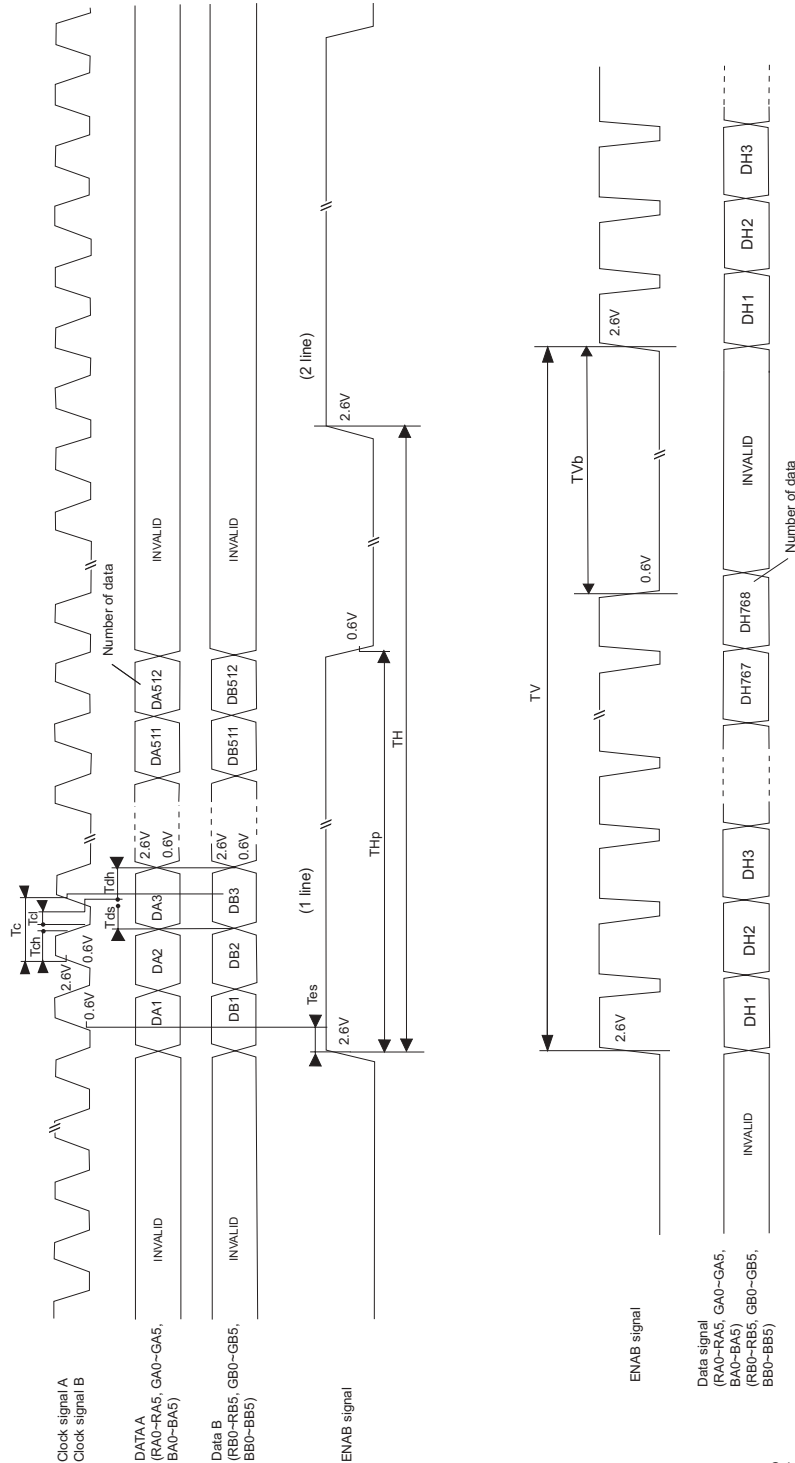
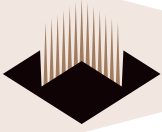
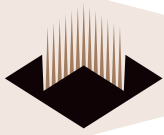


Fig 3 Input Signal Waveforms (ENAB Mode)



INPUT SIGNALS, BASIC DISPLAY COLORS AND GRAY SCALE OF EACH COLOR

Basic Colors	Colors & Gray scale	Data Signal																		
		Gray Scale	RA0	RA1	RA2	RA3	RA4	RA5	GA0	GA1	GA2	GA3	GA4	GA5	BA0	BA1	BA2	BA3	BA4	BA5
			RB0	RB1	RB2	RB3	RB4	RB5	GB0	GB1	GB2	GB3	GB4	GB5	BB0	BB1	BB2	BB3	BB4	BB5
	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	1	1	1	1	1	1	
	Green	-	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	
	Cyan	-	0	0	0	0	0	0	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	
	Magenta	-	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	
	Yellow	-	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	
	White	-	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	
	↑	GS1	1	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	
	↑	↓	↓						↓						↓					
	↓	↓	↓						↓						↓					
	Brighter	GS61	1	0	1	1	1	1	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	
	Red	GS63	1	1	1	1	1	1	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	
	↑	GS1	0	0	0	0	0	0	1	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	
	↑	↓	↓						↓						↓					
	↓	↓	↓						↓						↓					
	Brighter	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	
	↓	GS62	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	
	Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	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	
	↑	GS1	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	1	0	0	0	0	
	↑	↓	↓						↓						↓					
	↓	↓	↓						↓						↓					
	Brighter	GS61	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	1	1	1	1	1	
	Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	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.



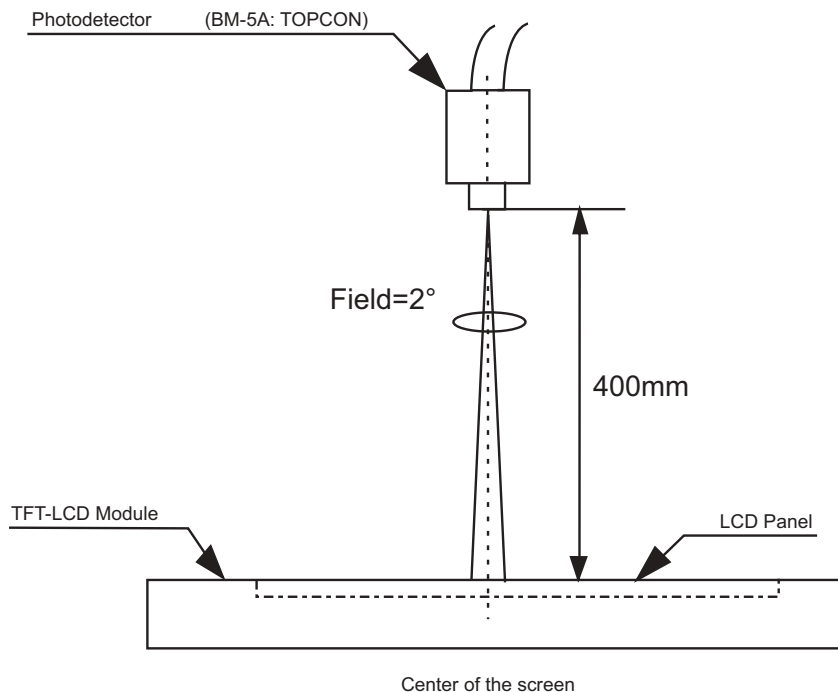
OPTICAL CHARACTERISTICS

T_A=25°C, V_{CC}=+5V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ 21,θ 22	CR>5	60	70	—	Deg.	(1,4)
	Vertical	θ 11		45	60	—	Deg.	
		θ 12		50	60	—	Deg.	
Contrast ratio		CRn	θ = 0°	200	300	—	—	(2,4)
Response time	Rise	tr		—	10	25	ms	(3,4)
	Decay	td		—	35	50	ms	
Chromaticity of white		x		0.283	0.313	0.343	—	(4)
		y		0.299	0.329	0.359	—	
Chromaticity of red		x		0.548	0.578	0.608	—	(4)
		y		0.302	0.332	0.362	—	
Chromaticity of green		x		0.280	0.310	0.340	—	(4)
		y		0.520	0.550	0.580	—	
Chromaticity of blue		x		0.123	0.153	0.183	—	(4)
		y		0.100	0.130	0.160	—	
Luminance of white IM film IM, RP		Y _{LI}		150 200	200 300	— —	cd/m ²	I _L =6.0mArms (4)
White Uniformity		δw		—	—	1.35	—	(5)

The measurement shall be executed 30 minutes after lighting at rating. (typical condition: I_L=6mArms)

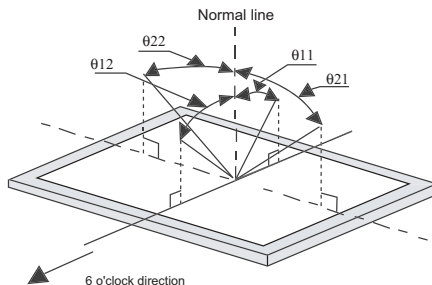
The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.4 below.





Notes:

1) Definitions of viewing angle range:

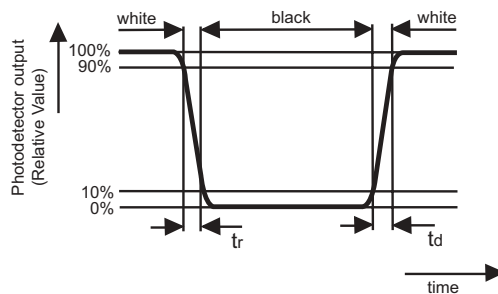


2) Definition of contrast ratio:

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

3) Definition of response time:

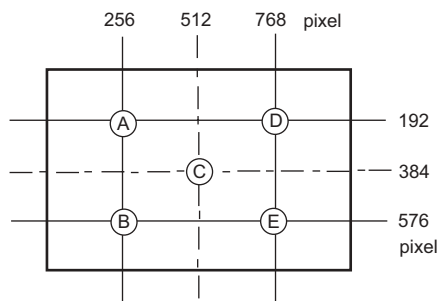
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



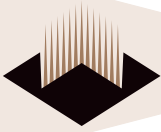
4) This shall be measured at the center of the screen.

5) Definition of white uniformity:

White uniformity is defined as the following with five measurements (A~E).



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



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) Since prolonged contact with water may cause discoloration or spots, wipe off water drops immediately.
- 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 make sure that one is grounded when handling.
- h) This module has its circuitry PCBs on the rear side and should be carefully handled in order not to be stressed.
- i) When desinging the cabinet, take into consideration the access to the backlight assembly.
- j) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issues, functional defect, etc. Such a design should be avoided.

PACKING FORM

- | | |
|--|----------------------------------|
| a) Piling number of cartons | : 5 cartons |
| b) Packing quantity in one carton | : 5 modules |
| c) Carton size | : 410mm(W) X 500mm(D) X 225mm(H) |
| d) Total weight of one carton filled with full modules | : 8850g |



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 : 11 ms, sine wave Direction: ±X, ±Y, ±Z once for each direction.

(Result Evaluation Criteria)

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

OTHERS

- 1) Disassembling the module can cause permanent damage and should be strictly avoided.
- 2) Image retention may occur when a fixed pattern is displayed for a long period of time.

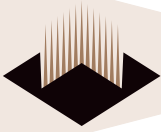
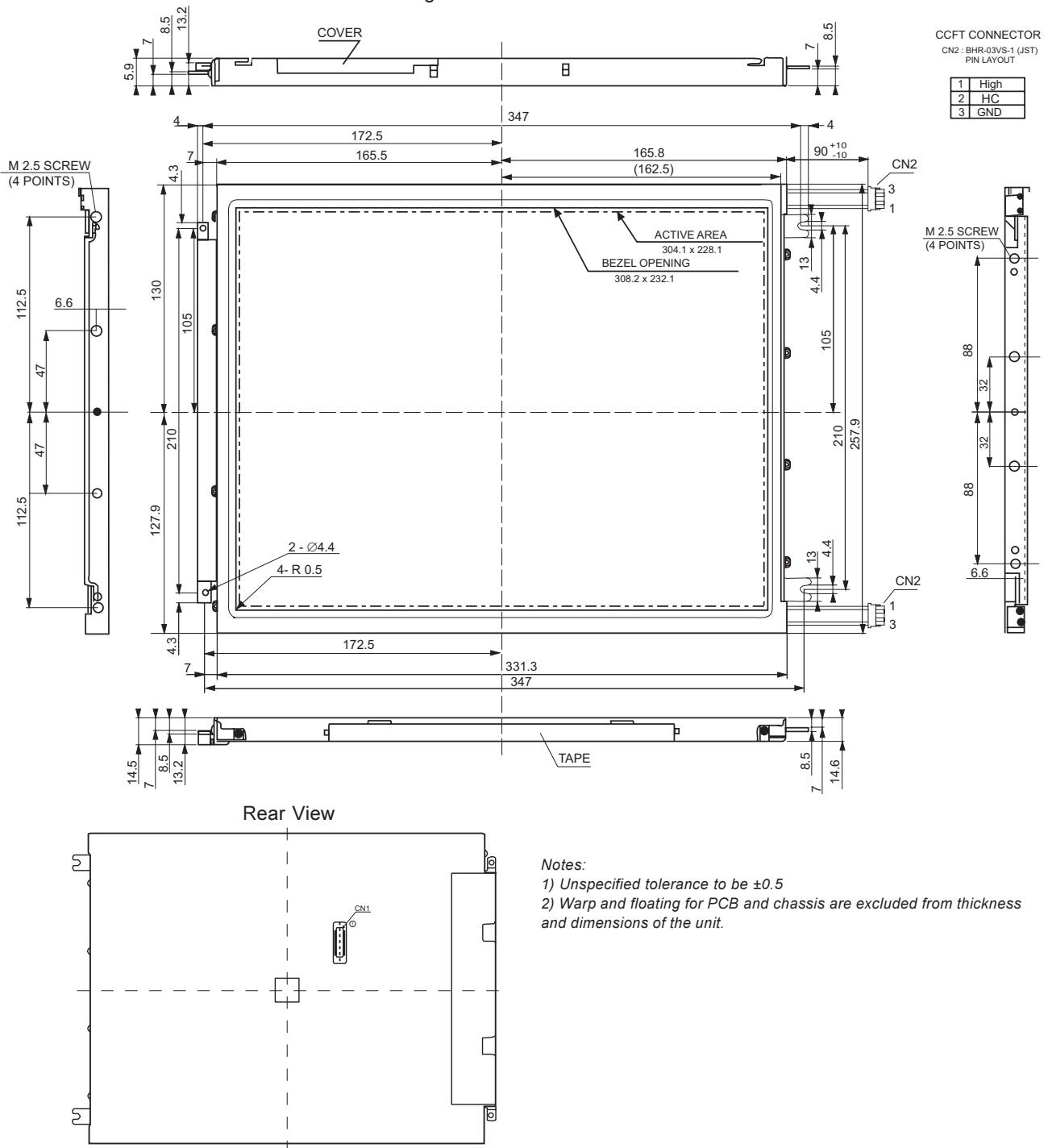


Fig. 1 Outline Dimensions



Original specifications created by Sharp.