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) providing for up to 40% increase in brightness.

This module is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit and a backlight unit. Graphics and text can be displayed on a 1024 x 3 x 768 dot panel with 262, 144 color by supplying 36-bit data signal (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	R,G,B vertical stripe	-
Display mode	Normally white	-
Unit outline dimensions (1)	335 (W) x 257.9 (H) x 15.9(D)	mm
Mass	1400 (max)	g
Surface treatment	IM/Clear (glossy) or IM/110 and hardcoat 3H	-

Note:

1. Excluding backlight cables.
   The thickness of module (D) does not contain the projection
2. Outline dimensions are shown in Fig 1.

INPUT TERMINALS

TTL-LCD Panel Driving

CN1 The module-side connector :FX8-60S-SV (Hirose Electric Co., Ltd.)
The user-side connector :FX8-60S-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 (LSB)
13	GB4	GREEN even data signal
14	GB5	GREEN even data signal
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 (LSB)
34	GA4	GREEN odd data signal
35	GA5	GREEN odd data signal
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	V_{SYNC}	Vertical synchronous signal
47	H_{SYNC}	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	V_{CC}	+5V power supply
58	V_{CC}	+5V power supply
59	V_{CC}	+5V power supply
60	V_{CC}	+5V power supply

Note:

*The shielding case is connected with GND. in the module

1. In case MODE is fixed "Low", the display start timing is determined by V_{SYNC} 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 on "High" or "Open", the display start timing is determined by only ENAB.

BACKLIGHT DRIVING

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

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Ratings	Unit
Input voltage (1)	V_I	t_A=25°C	-0.3~ + 5.5	V
+5.0V Supply voltage	V_{CC}	t_A=25°C	0~ + 6	V
Storage temperature (2)	t_{STG}	-	-25~ + 60	°C
Operating temperature (Ambient)(2)	T_{OPA}	-	0~ + 50	°C

Notes:
1. CKA, CKB, RAO~RA5, GA0~GA5, BA0~BA5, RB0~RB5, GB0~GB5, BB0~BB5, H_{SYNC}, V_{SYNC}, ENAB, MODE
2. Humidity: 95%RH Max. at $t_A \leq 40$°C. Maximum wet-bulb temperature at 39°C or less at $t_A \leq 40$°C. No condensation.

ELECTRICAL CHARACTERISTICS

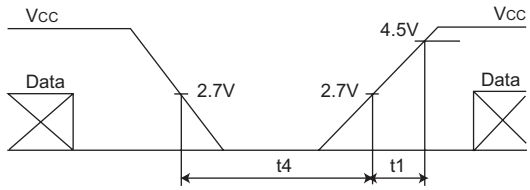
TFT-LCD PANEL DRIVING, t_A=25°C

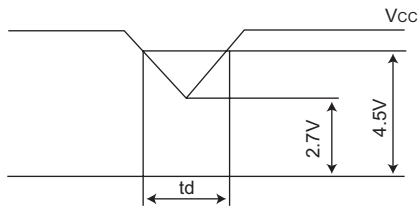
Parameter		Symbol	MIN	TYP	MAX	Unit	Remarks
V_{CC}	Supply voltage	V_{CC}	+4.5	+5.0	+5.5	V	(1)
	Current dissipation	I_{CC}	-	300	450	mA	(2)
Permissive input ripple voltage		V_{RF}	-	-	100	mVp-p	V_{CC}=+5.0V
Input voltage (Low)		V_{IL}	GND	-	0.6	V	(3)
Input voltage (High)		V_{IH}	2.6	-	V_{CC}	V	
Input current (Low)		I_{IL}	-	-	10	µA	V_I=GND (3)
			-	-	400	µA	V_I=GND (4)
Input current (High)		I_{IH}	-	-	10	µA	V_I=V_{CC}(3)
			-	-	600	µA	V_I=V_{CC}(4)

3.3(v) logic is recommended as input signals.

Notes:

1. On-Off conditions for supply voltage
   0 < t1 ≤ 10ms
   t4 ≥ 1s

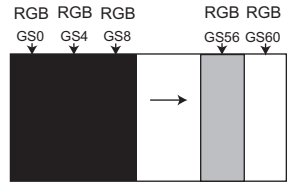




V_{CC}-dip conditions

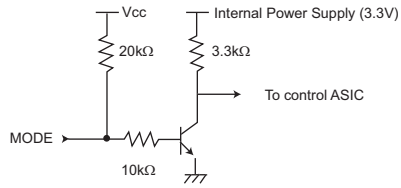
1. 2.7V ≤ V_{CC} < 4.5V
   td ≤ 10ms
2. V_{CC} < 2.7V
   V_{CC}-dip conditions should also follow the V_{CC}-turn-on conditions

2. Typical current situation: 16-gray-bar pattern
   V_{CC}=+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, RAO~RA5, GA0~GA5, BA0~BA5, RB0~RB5, GB0~GB5, BB0~BB5, H_{SYNC}, V_{SYNC}, ENAB

4. MODE
   Input circuit of MODE is shown in right figure.



BACKLIGHT DRIVING SECTION

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

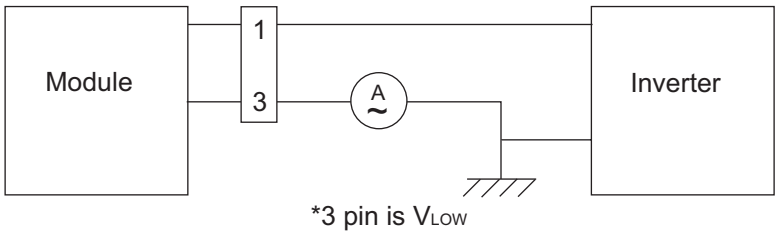
The characteristics of a single lamp are shown in the folliowing table. t_A=25°C

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

Parameter	Symbol	MIN	TYP	MAX	Unit	Remark
Lamp current	I_L	2.5	6.0	6.5	mArms	(1)
Lamp voltage	V_L	-	690	-	Vrms	t_A=25°C
Lamp power consumption	P_L	-	4.1	-	W	(2)
Lamp frequency	F_L	20	60	70	KHz	(3)
Kickoff voltage	V_S	-	-	850	Vrms	t_A=25°C
		-	-	1450	Vrms	t_A=0°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 VLOW 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



*3 pin is V_{LOW}

2. Referential data per one CCFT by calculation (I_L x 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 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 be turned on.
5. Lamp life time is defined as the time when either (1) or (2) under the continuous operation under the condition of t_A=25°C and IL=6.0 ± 0.5mArms)
   1. Brightness becomes 50% of the original value under standard condition.
   2. Kick-off voltage at t_A=0°C exceeds maximum value,1450 Vrms.

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 (mis-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 Clock		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
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
H_{SYNC}-Clock phase difference		TF_C	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 start		TV_{BP}	35	35	35	line
$H_{SYNC.}$-$V_{SYNC.}$ phase difference		TV_H	1	-	TH-TH_P	clock

Notes: 1. In case of lower frequency, deterioration of the 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 ENAB signal is displayed at the left end of the active area.

Parameter		Symbol	MIN	TYP	MAX	Unit
Enable signal	Set-up time	T_{ES}	8	-	Tc-10	ns
	Pulse width	T_{EP}	10	512	512	clock
H_{SYNC}-enable signal phase difference		TH_E	TH_P + 1	148	TH-512	clock

Do not keep ENAB "Low" during operation.

VERTICAL DISPLAY POSITION

The vertical display position is the 35th line from the falling edge of V_{SYNC} (Fig. 2)

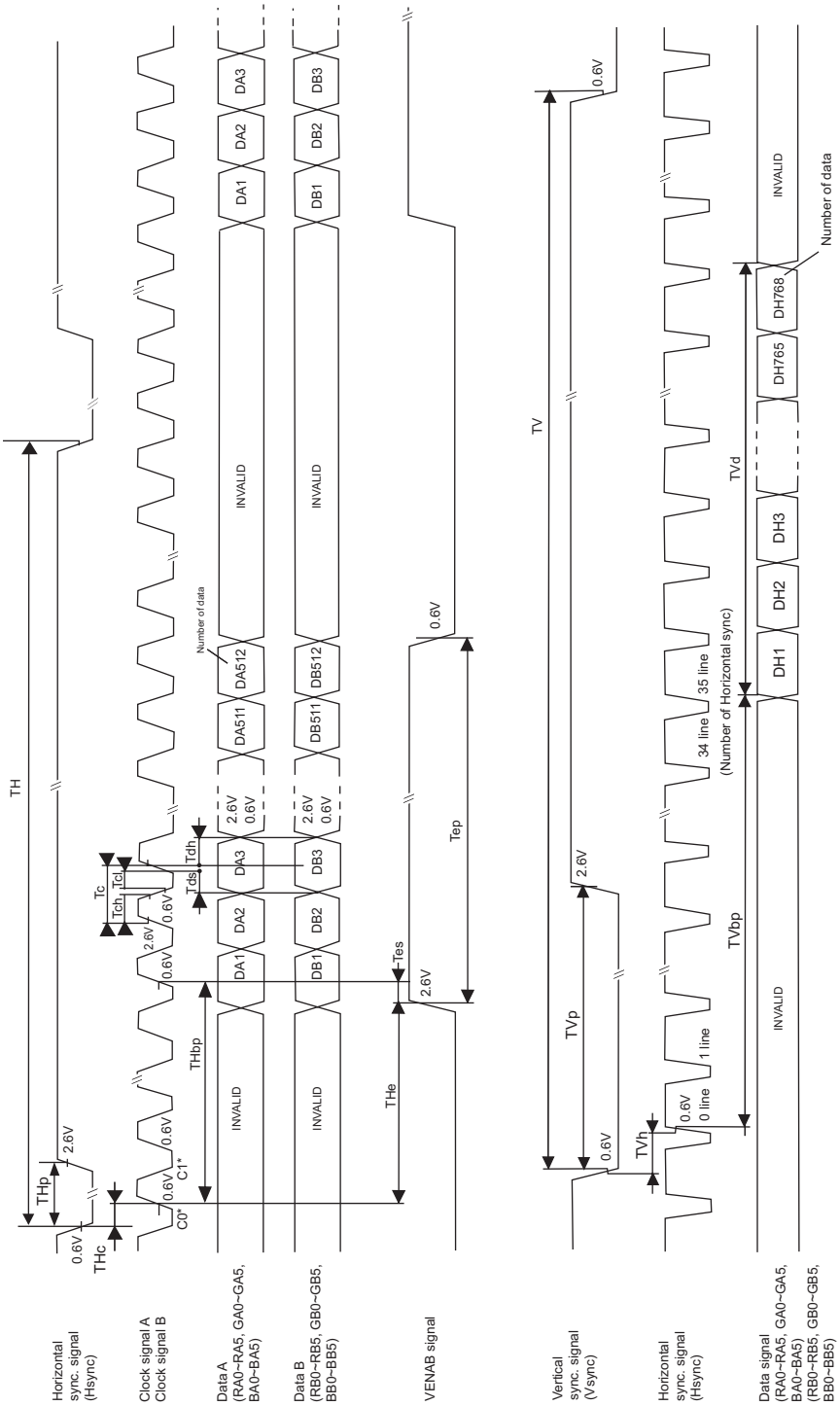


Fig 2 Input Signal Waveforms (H-V Mode)

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

Timing diagrams of input signal are shown in Fig. 3

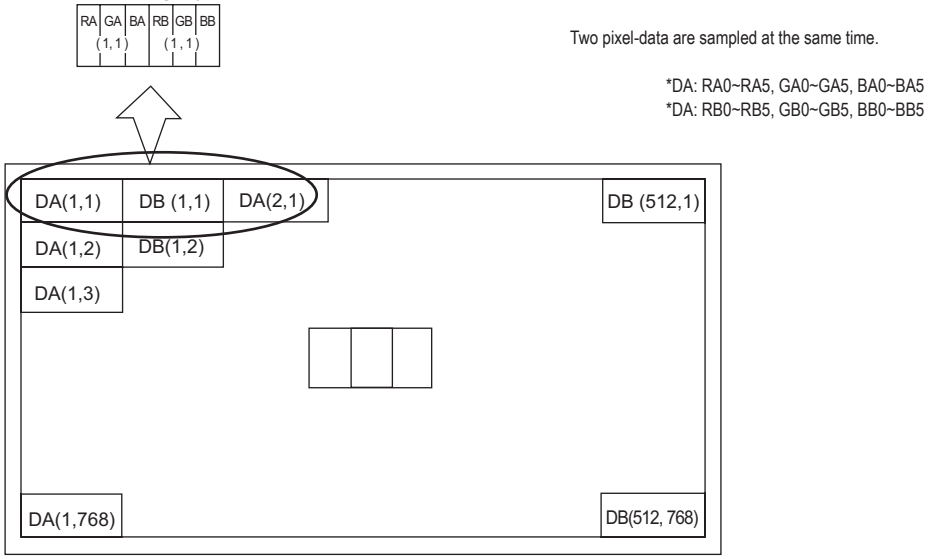
TIMING CHARACTERISTICS

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock A Clock B	Frequency	I/Tc	25	32.5	40	MHz
	Hi time	Tch	9	-	-	ns
	Low time	Tcl	9	-	-	-
	Duratio	TcW Tcl	0.67	1.00	1.50	-
Data	Se time	Tds	8	-	-	ns
	Hold time	Tdh	8	-	-	us
Data enable signal	Setup time	Tes	8	-	Tc 10	ns
	Horizontal period	TH	16.6	20.7	-	U s
			528	672	860	clock
	Horizontal period	THp	10	512	512	clock
	Vertical period	TV	770	806	990	line
	Vertical blanking width	TVb	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

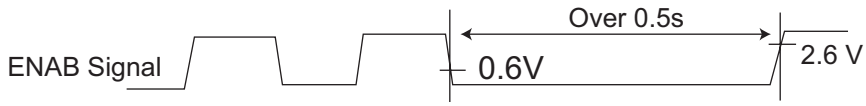
Graphics and text can be displayed at 1024 x 3 x 768 dots on a panel with 262, 144 colors by supplying 36 bit data signal (6bit/color [64 gray scale] x 3 x 2 pixel).



Display position of Input data (H,Y)

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.



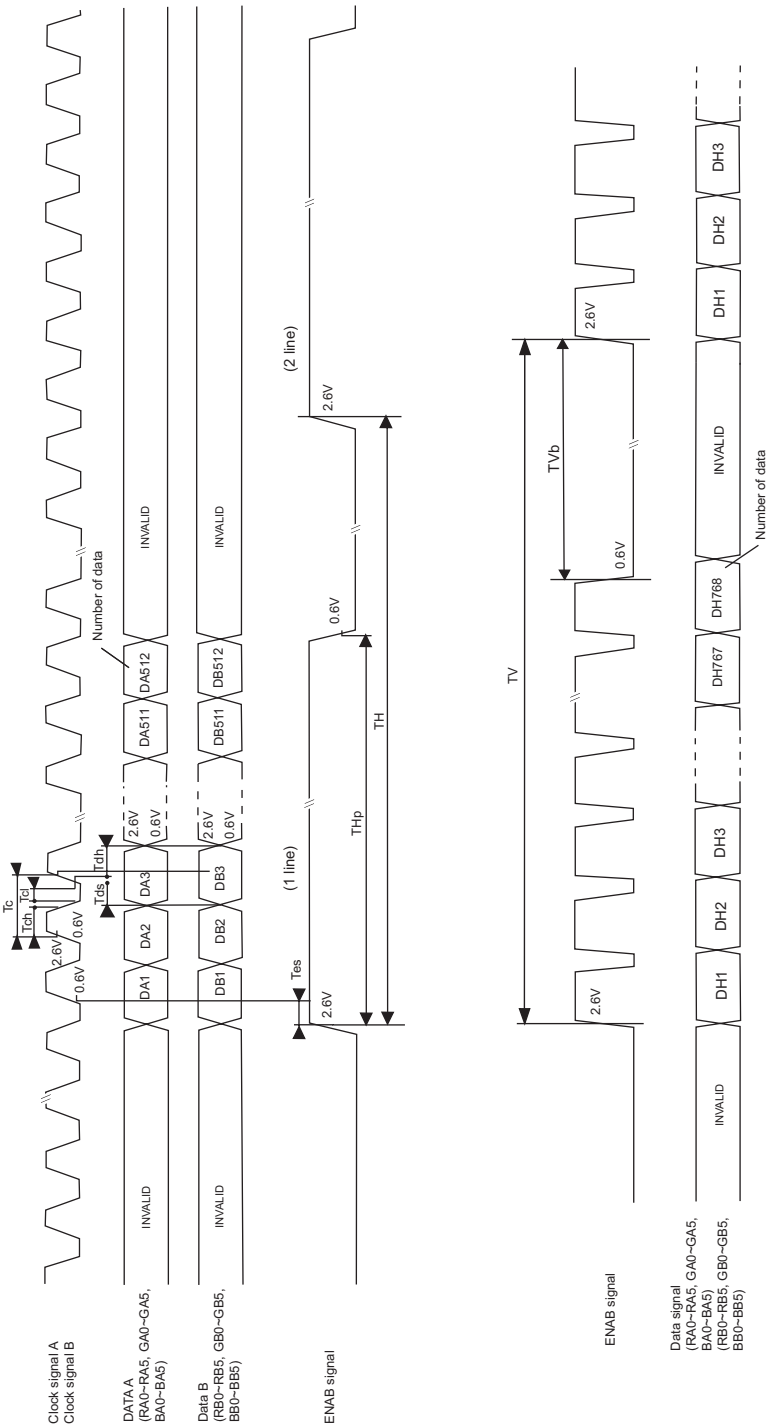


Fig 3 Input Signal Waveforms (ENAB Mode)

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

	Colors & Grayscale	Gray Scale	Data signal																	
			RA0	RA1	RA2	RA3	RA4	RA5	GA6	GA7	GA2	GA3	GA4	GA5	BA0	BA1	BA2	BA3	BA4	BA5
			RB0	RB1	RB2	RB3	RB4	RB5	GB6	GB7	GB2	GB3	GB4	GB5	BB0	BB1	BB2	BB3	BB4	BB5
Basic Color	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
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ Darker	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	↓ Brighter	GS250	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		GS251	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS252	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
	↑ Darker	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	↓ Brighter	GS250	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
		GS251	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	GS252	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
	↑ Darker	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	↓ Brighter	GS250	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
		GS251	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Blue	GS252	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Notes:

1. 0: Low level voltage 1: High level voltage.
2. Each basic color can be displayed in 64 gray scales from 6 bit data signals.
3. 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	Remarks
Viewing Angle Range	Horizontal	θ21, θ22	CR≥5	60	70	-	Deg.	(1, 4)
	Vertical	θ11		45	60	-	Deg.	
		θ12		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		0.549	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	IL=6.0mArms (4)
White Uniformity		δw		-	-	1.35	-	(5)

Notes:

1. The measurements 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.

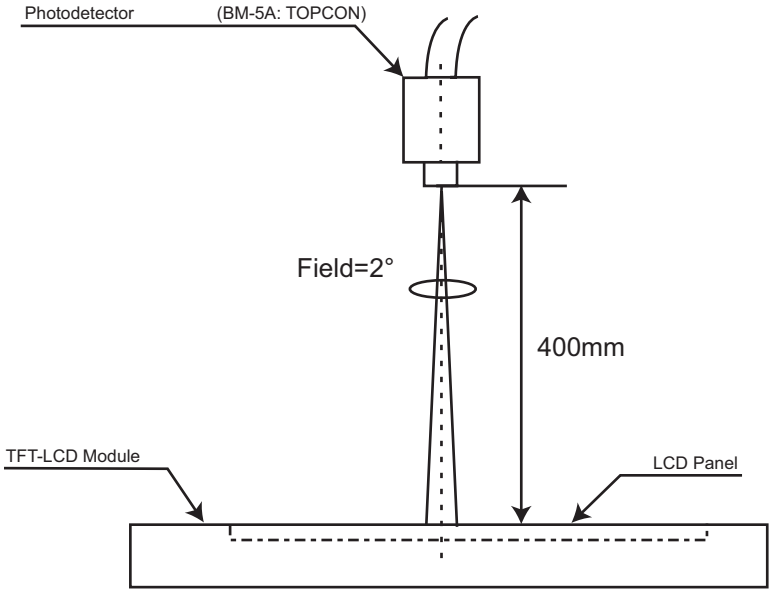
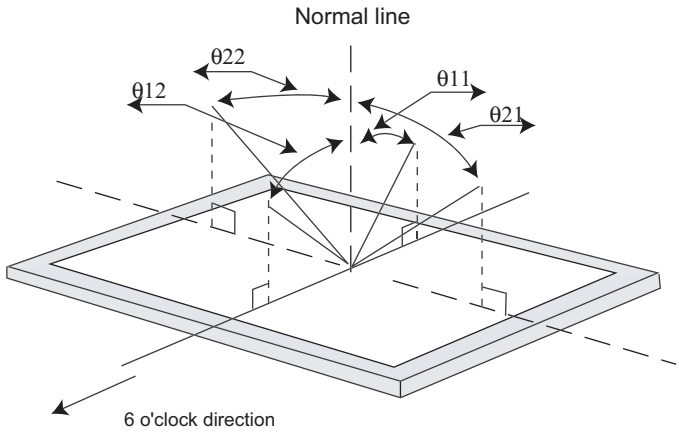


Fig. 4. Optical Characteristics Measurement Method

Notes:

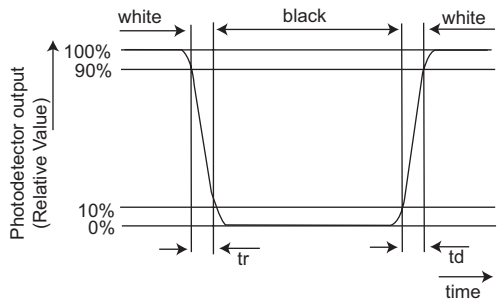
1. Definition of viewing angle range:



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".

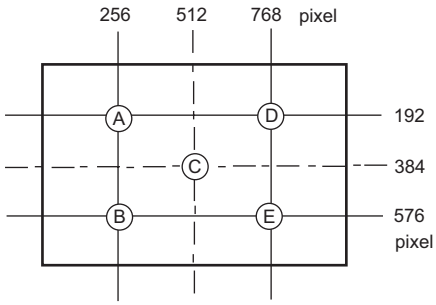


4. This shall be measured at the center of the screen.

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

1. Be sure to turn off the power supply when inserting or disconnecting the cable.
2. Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
3. Since the front polarizer is easily damaged, pay attention not to scratch it.
4. Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
5. When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
6. Since the panel is made of glass, it may break crack or internal wire breaking if dropped or bumped on hard surface. Handle with care.
7. Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.
8. This module has its circuitry PCBs on the rear side and should be carefully handled in order not to be stressed.
9. When designing the cabinet, take into consideration the access to the backlight assembly.
10. 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

1. Piling number of cartons: 5 cartons
2. Package quantity in one carton: 5 modules
3. Carton size: 410mm(W)x 225mm(H) x 500mm(D)
4. Total weight of 1 carton filled with full modules: 8850g

OTHERS

1. Disassembling the module can cause permanent damage and should be strictly avoided.
2. Be careful since image retention may occur when a fixed pattern is displayed for a long time.

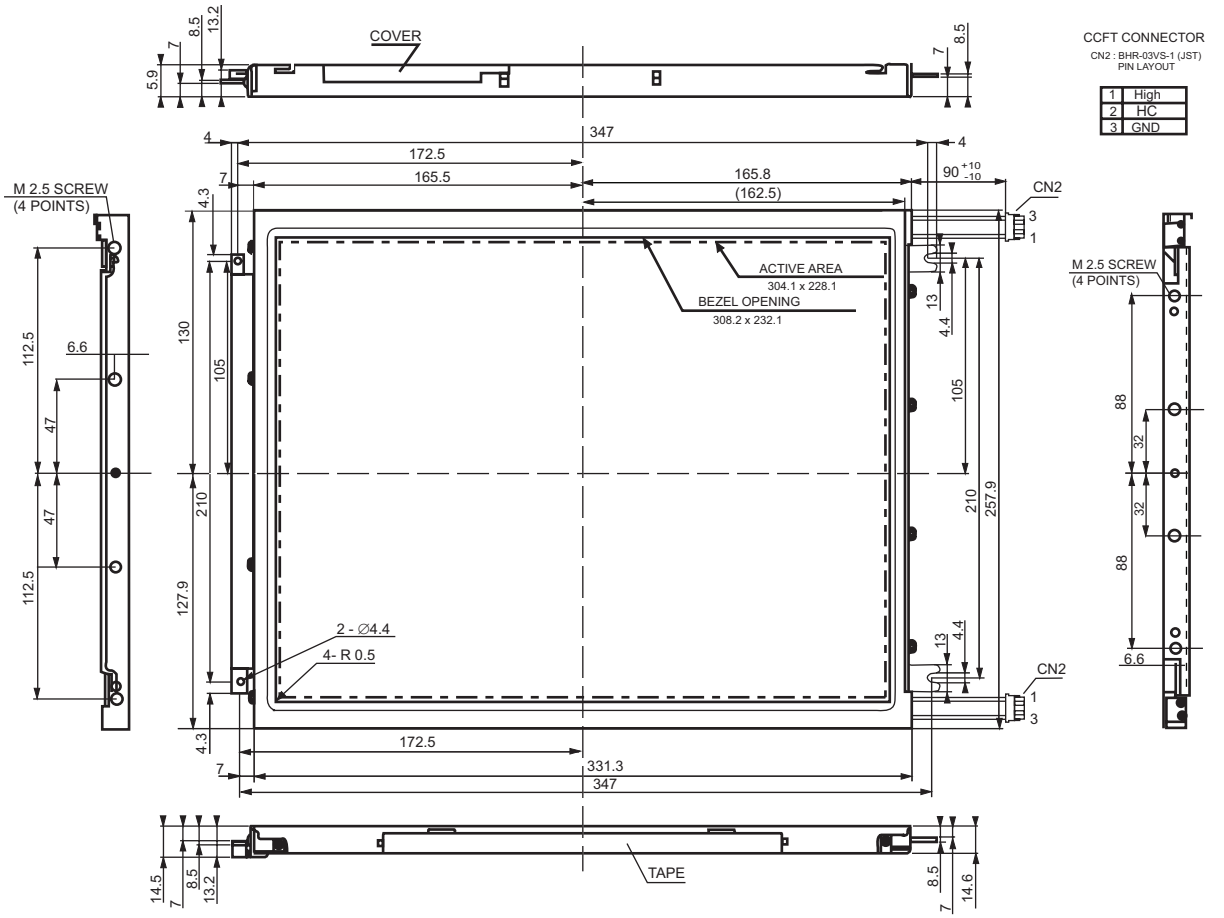
RELIABILITY TEST ITEMS

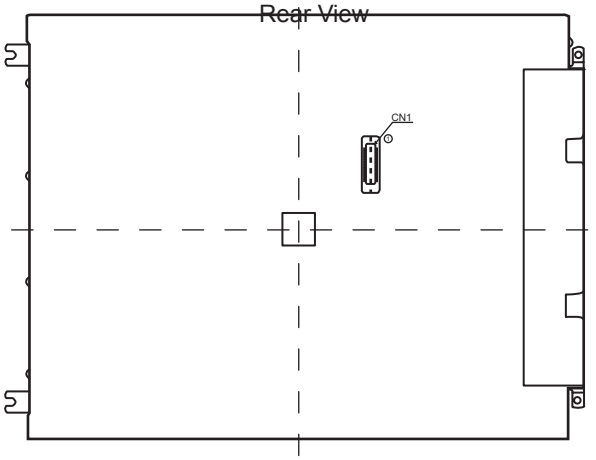
No.	Test items	Conditions	
1	High temperature storage test	t_A=60°C	240h
2	Low temperature storage test	t_A=-25°C	240h
3	High temperature and high humidity operating test	t_A=40°C, 95%RH (No condensation)	240h
4	High temperature operating test	t_A=50°C (The panel temp. must be less than 60°C)	240h
5	Low temperature operating test	t_A=-0°C	240h
6	Vibration Test (Non-operating)	Frequency Sweep time Test Period	:10~57Hz/Vibration width (one side): 0.075mm :58~500Hz/Gravity: 9.8m/s^2 :11 minutes, sine wave :3 hours (1 hour for each direction of X, Y, Z)
7	Shock test (non-operating)	Max gravity Pulse width Direction	:490m/s^2 :11 minutes, half sine wave :±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.

Fig. 1 Outline Dimensions





Notes:

1. UNSPECIFIED TOLERANCE TO BE ±0.5
2. WARP AND FLOATING FOR PCB AND CHASSIS ARE EXCLUDED FROM THE THICKNESS AND DIMENSIONS OF THE UNIT.