



ENH064V1-800 Color TFT-LCD Module Features

GENERAL DESCRIPTION

WEDC provides optically enhanced solutions to the standard Sharp LQ64D343 color active matrix LCD module. The ENH064V1-800 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 an enhanced light guide (ELG) providing for up to 30% increase in brightness.

This module 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 x RGB x 480 dot panel with 262,144 colors by supplying 18-bit data signal (6-bit/color), four timing signals, +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 multimedia use. Viewing angle is 6 o'clock direction. This module offers a wide viewing angle and high brightness (800cd/m²). Backlight-driving DC/AC inverter is not built in this module.

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

MECHANICAL SPECIFICATIONS

Parameter	Specifications	Unit
Display Size	16 (6.4") Diagonal	cm
Active Area	130.6(H) x 97.0(V)	mm
Pixel Format	640(H) x 480(V) (1 pixel=R+G+B dots)	pixel
Pixel Pitch	0.204(H) x 0.202(V)	mm
Pixel Configuration	RGB vertical stripe	-
Display Mode	Normally white	-
Unit Outline Dimensions (1)	175.0(W) x 126.5(H) x 16.0(D)	mm
Mass	290 ± 20	g
Surface Treatment	IM/Clear (glossy) or IM/110 and hardcoat 3H	-

Note:

1. Excluding backlight cables.



INPUT TERMINALS

TFT-LCD panel driving



CN1 pin arrangement from module surface
(Transparent view)

CN1 Used connector: DF9BA-31P-1V (Hirose Electric Co., Ltd.)
Corresponding connector: DF9-31S-1V (Hirose Electric Co., Ltd.)
DF9A-31S-1V (Hirose Electric Co., Ltd.)
DF9B-31S-1V (Hirose Electric Co., Ltd.)
DF9M-31S-1V (Hirose Electric Co., Ltd.)

Pin No.	Symbol	Function	Remark
1	GND	-	-
2	CK	Clock signal for sampling each data signal	-
3	Hsync	Horizontal synchronous signal	(1)
4	Vsync	Vertical synchronous signal	(1)
5	GND	-	-
6	R0	RED data signal (LSB)	-
7	R1	RED data signal	-
8	R2	RED data signal	-
9	R3	RED data signal	-
10	R4	RED data signal	-
11	R5	RED data signal (MSB)	-
12	GND	-	-
13	G0	GREEN data signal (LSB)	-
14	G1	GREEN data signal	-
15	G2	GREEN data signal	-
16	G3	GREEN data signal	-
17	G4	GREEN data signal	-
18	G5	GREEN data signal (MSB)	-
19	GND	-	-
20	B0	BLUE data signal (LSB)	-
21	B1	BLUE data signal	-
22	B2	BLUE data signal	-
23	B3	BLUE data signal	-
24	B4	BLUE data signal	-
25	B5	BLUE data signal (MSB)	-
26	GND	-	-
27	ENAB	Signal to settle the horizontal display position	(2)
28	Vcc	+5.0V power supply	-
29	Vcc	+5.0V power supply	-
30	R/L	Horizontal display mode select signal	(3)
31	U/D	Vertical display mode select signal	(4)

The shielding case is not connected with GND.

Notes:

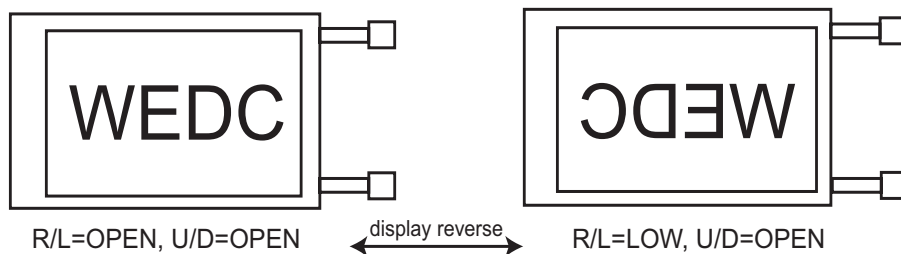
- 1) 480 line, 400 line or 350 line mode is selected by the polarity combination of both synchronous signals.
- 2) The horizontal display start timing is settled in accordance with a rising timing of ENAB signal. In case ENAB is fixed "Low", the horizontal start timing is determined as described in Horizontal Display Position, p. 6. Do not keep ENAB "High" during operation.

Mode	480 lines	400 lines	350 lines
Hsync	negative	negative	positive
Vsync	negative	positive	negative

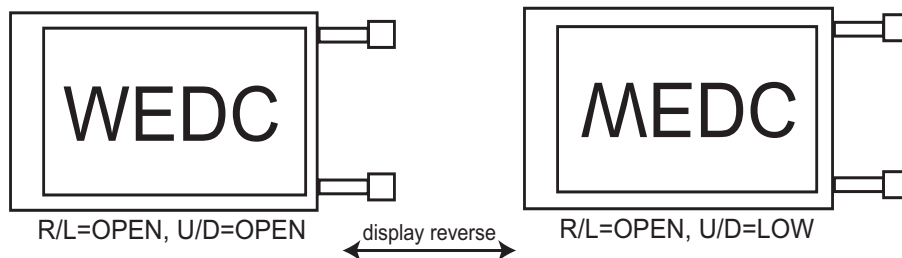
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3)



4)



Used connector: BHR-03VS-1(JST)
Corresponding connector: SM02(8.0)B-BHS(JST)

BACKLIGHT DRIVING
CNA, CNB

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	Remark
Input Voltage	V _I	T _a =25°C	-0.3~ V _{CC} + 0.3	V	(1)
+5V Supply Voltage	V _{CC}	T _a =25°C	0 ~ + 6	V	-
Storage Temperature	T _{stg}	-	-25 ~ + 70	°C	(2)
Operating Temperature (Ambient)	T _{opa}	-	0 ~ + 55	°C	

Notes:

1. CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB, R/L, U/D
2. Humidity : 95%RH Max. at T_a ≤ 40°C.
Maximum wet-bulb temperature at 39°C or less at T_a>40°C.
No condensation.



ELECTRICAL CHARACTERISTICS

TFT-LCD Panel Driving

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
+5V	Supply Voltage	V _{CC}	+4.5	+5.0	+5.5	V (1)
	Current Dissipation	I _{CC}	–	250	360	mA (2)
Permissible Input Ripple Voltage	V _{RF}	–	–	100	mVp-p	V _{CC} =+5V
Input Voltage (Low)	V _{IL}	–	–	0.3V _{CC}	V	(3)
Input Voltage (High)	V _{IH}	0.7V _{CC}	–	–	V	
Input Current (Low)	I _{OL1}	–	–	1.0	μA	V _I =0V (4)
	I _{OL2}	–	–	60.0	μA	V _I =0V (5)
Input Current (High)	I _{OH1}	–	–	1.0	μA	V _I =V _{CC} (6)
	I _{OH2}	–	–	60.0	μA	V _I =V _{CC} (7)

Notes:

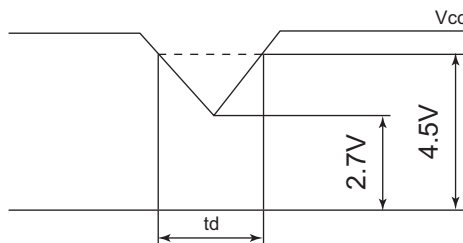
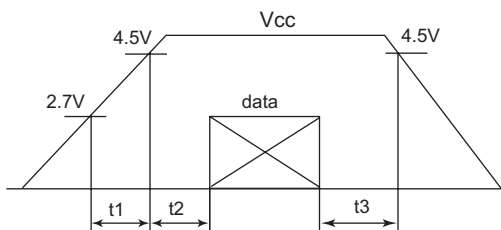
- V_{CC}-turn-on conditions
t₁ ≤ 10ms
0 < t₂ ≤ 10ms
0 < t₃ ≤ 1s

V_{CC}-dip conditions

- 2.7V ≤ V_{CC} < 4.5V
t_d ≤ 10ms

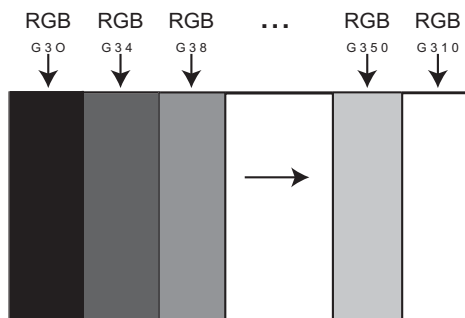
2) V_{CC} < 2.7V

V_{CC}-dip conditions should also follow the V_{CC}-turn-on conditions



Notes:

- Typical current situation : 16-gray-bar pattern
480 line mode
V_{CC} = +50V
- CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB, R/L, U/D
- CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB
- R/L
- CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync
- ENAB, U/D



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TA=25°C

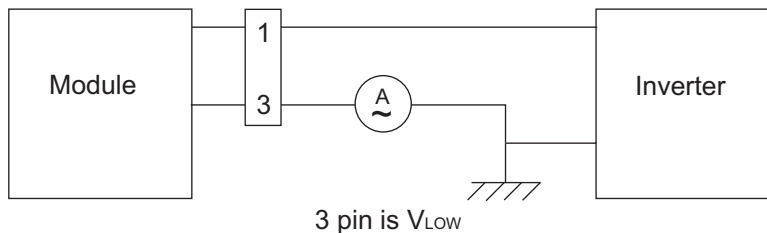
BACKLIGHT DRIVING

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp Current	I_L	2.0	6.0	6.5	mArms	(1)
Lamp Power Consumption	P_L	-	2.16	-	W	(2)
Lamp Frequency	F_L	20	35	60	KHz	(3)
Kick-off Voltage	V_s	-	-	800	Vrms	Ta=25°C
		-	-	1000	Vrms	Ta=0°C (4)
Lamp Life Time	L_L	-	25000	-	hour	(5)

Notes:

1) Lamp current is measured with current meter for high frequency as shown below.



- 2) At the condition of $Y_L=(300) \text{ cd/m}^2$
- 3) Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause horizontal 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.
- 4) The open output voltage of the inverter shall be maintained for more than 1 sec; otherwise the lamp may not be turned on.
- 5) Since lamp is consumable, the life time written above is referential value and is not guaranteed in this specification sheet by WEDC.
Lamp life time is defined that it applied either (1) or (2) under this condition (Continuous turning on at Ta=25°C, IL=6mArms)
 - 1) Brightness becomes 50% of the original value under standard condition.
 - 2) Kickoff voltage at Ta=0°C exceeds maximum value, 1000 Vrms. If 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, periodic lamp exchange by WEDC is recommended.

Note:

- 1) 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 certain 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.

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TIMING CHARACTERISTICS OF INPUT SIGNALS

Timing diagrams of input signal are shown in Fig. 2-1~3.

TIMING CHARACTERISTICS

Parameter	Symbol	Mode	Min.	Typ.	Max.	Unit	
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
			↑	770	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
	Pulse Width	TVp	all	2	-	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:

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	Tes	5	-	Tc-10	ns
	Pulse width	Tep	2	640	640	clock
Hsync-Enable Signal Phase Difference		THE	44	-	TH-664	clock

Note:

1) When ENAB is fixed "Low", the display starts from the data of C104 (clock) as shown in Fig. 2-1~3. Be careful the module does not work when ENAB is fixed "High".



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 Note 1 on page 2.

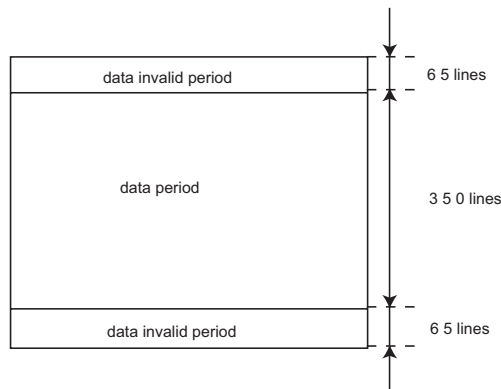
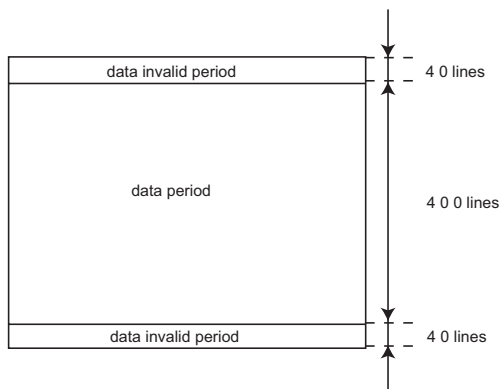
In each mode, the data of TVn is displayed on the top line of the active area. The display position will be centered

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 “()” is recommended during vertical data invalid period.

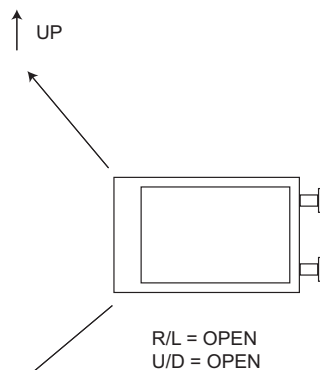
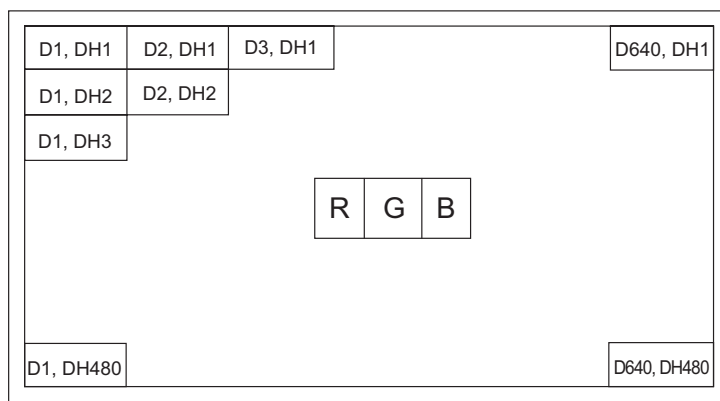
ENAB signal has no relation to the vertical display position.

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



INPUT DATA SIGNALS AND DISPLAY POSITION ON THE SCREEN

Display position of input data (480 lines mode)



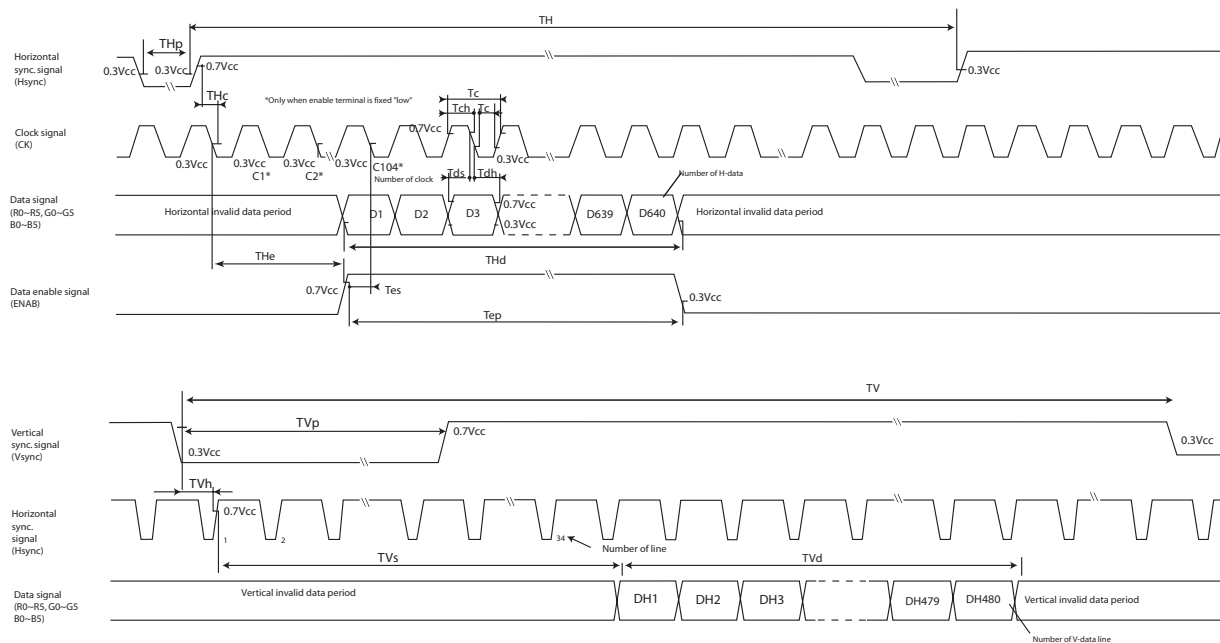


Fig 2-1 Input signal waveforms (480 line mode)

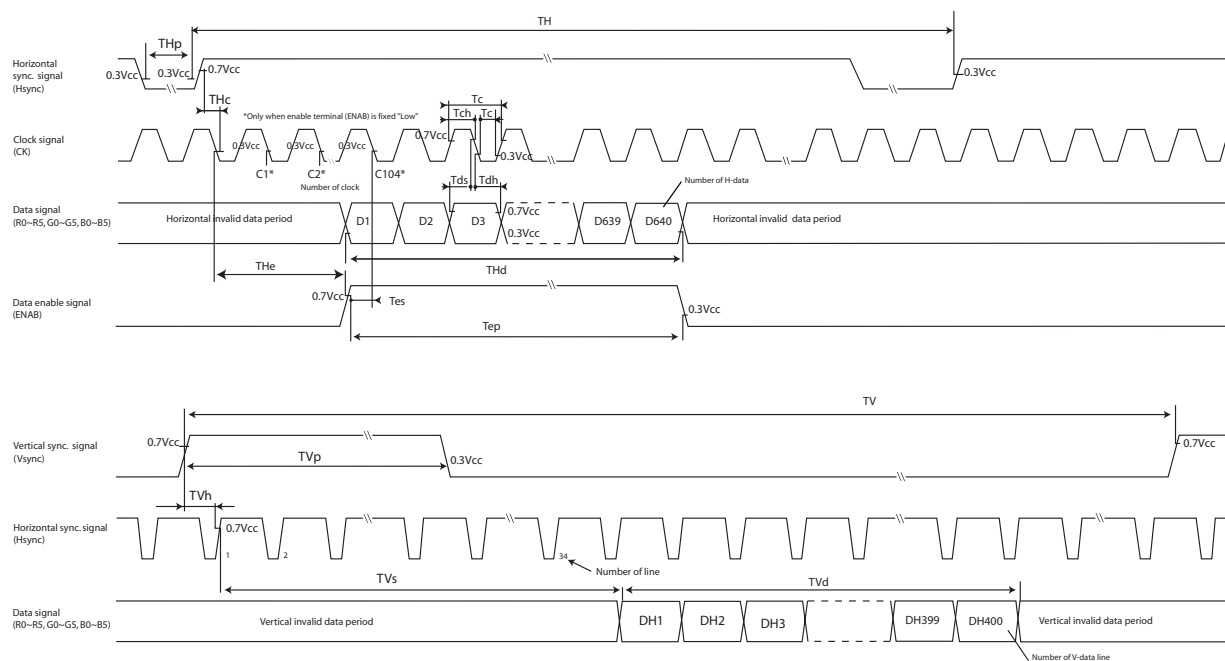


Fig. 2-2 Input signal waveforms (400 line mode)

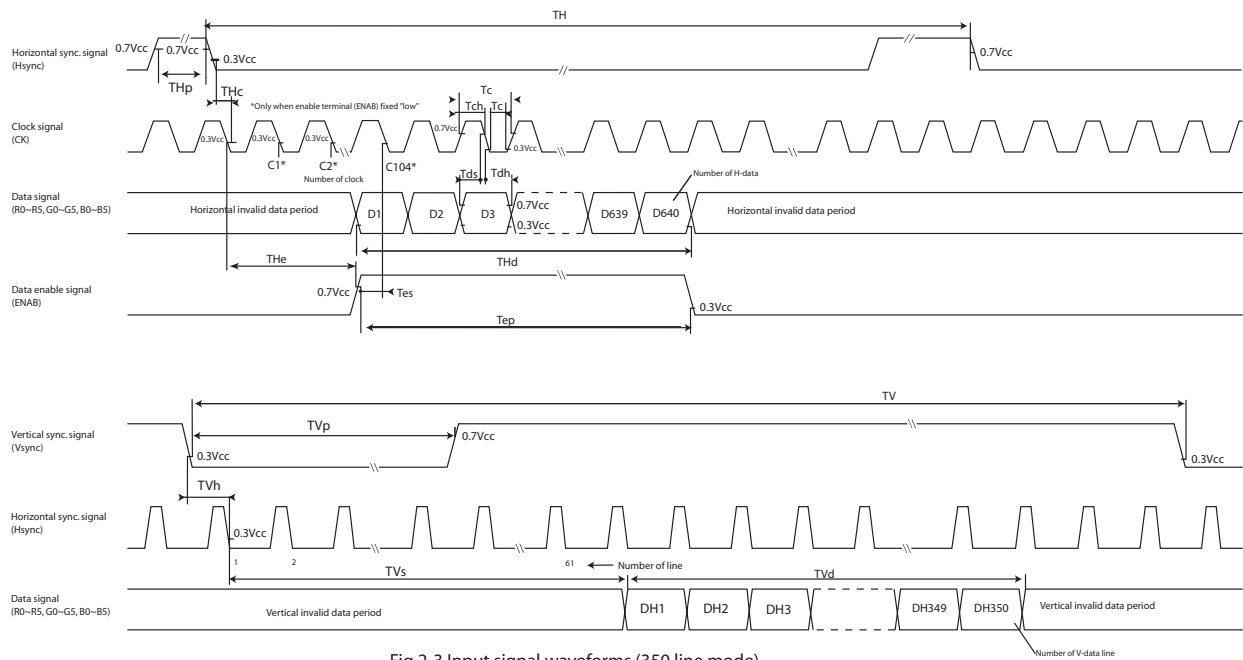


Fig 2-3 Input signal waveforms (350 line mode)



INPUT SIGNALS, BASIC DISPLAY COLOR 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	
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	1	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	GS61	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
		GS62	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
	Red	GS63	0	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		GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	
		GS6	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
		↑ 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	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	

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.
According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.



OPTICAL CHARACTERISTICS

Ta=25°C, Vcc=+5V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	$\theta 21$	(CR \geq 5)	60	70	-	Deg.	(4)
		$\theta 22$		60	70	-	Deg.	
	Vertical	$\theta 11$		35	40	-	Deg.	
		$\theta 12$		55	70	-	Deg.	
Contrast Ratio		CR	Best Viewing Angle	100	-	-	-	(2,4)
Response Time	Rise	tr	$\theta = 0^\circ$	-	20	-	ms	(3,4)
	Decay	td		-	40	-	ms	
Chromaticity of White		X		-	0.313	-	-	(4)
		Y		-	0.325	-	-	
Luminance of White		YL		700	800	-	cd/m ²	
White Uniformity		δw		-	-	1.45	-	(5)
Viewing Angle Range as a Brightness Definition	Horizontal	$\theta 21$	50% of the maximum brightness	-	45	-	Deg.	(1)
		$\theta 22$		-	45	-	Deg.	
	Vertical	$\theta 11$		-	45	-	Deg.	
		$\theta 12$		-	45	-	Deg.	

Note:

- 1) The measurement shall be executed 30 minutes after lighting at rating. (typical condition: L=6mA_{rms}) The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig. 3 below.

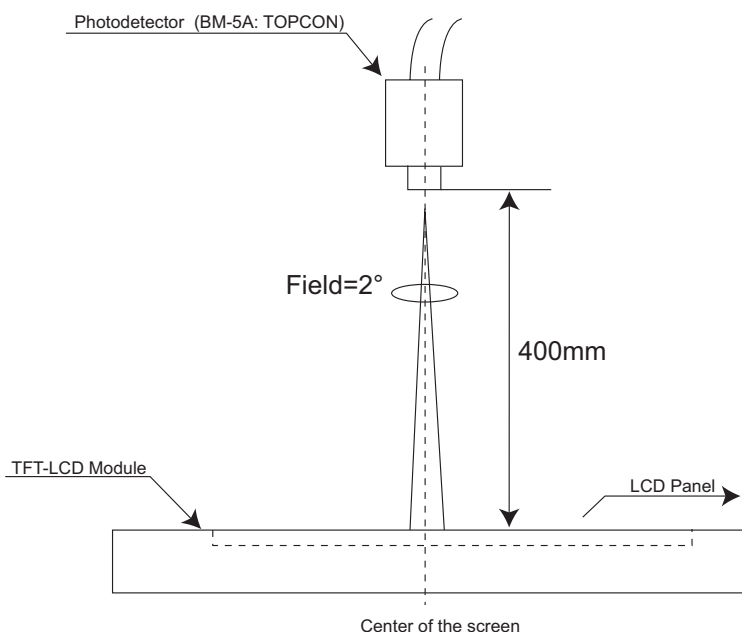
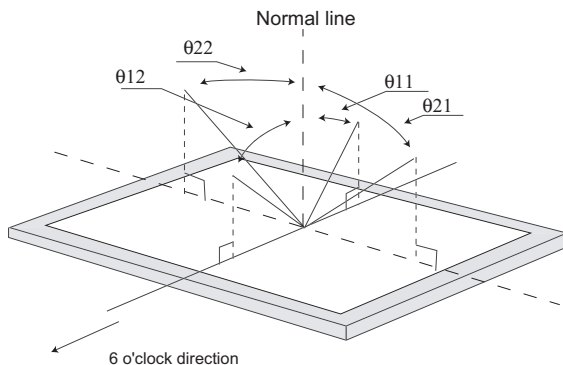


Fig. 3 Optical Characteristics Measurement Method



Notes:

1) Definitions of viewing angle range:



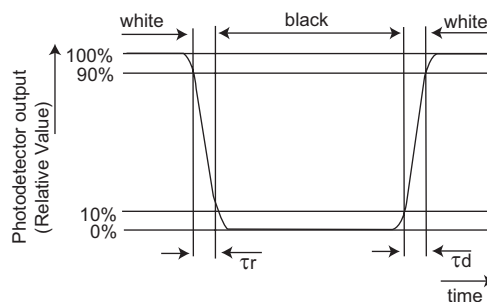
2) Definition of contrast ratio:

The contrast ratio is defined as the following.

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

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".



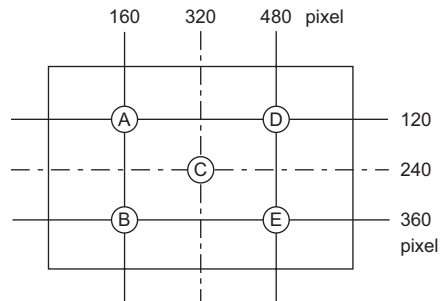
4) This shall be measured at center of the screen.

5) Definition of white uniformity:

White uniformity is defined as the following with five measurements.

(A-E).

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





DISPLAY QUALITY

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

HANDLING PRECAUTIONS

- 1) Be sure to turn off the power supply when inserting or disconnecting the cable.
- 2) 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 to avoid rubbing with something hard or sharp.
- 4) Wipe water off immediately. Long contact with water may cause discoloration or spots.
- 5) When the panel surface is soiled, use an absorbent cotton or other soft cloth to wipe it off.
- 6) Since the panel is made of glass, refined wires and components, it may break, crack or cause internal wire breaking if dropped or bumped on hard surface. Handle with care.
- 7) Since CMOS LSI is used in this module, make certain one is grounded when handling.
- 8) Observe all other precautionary requirements in handling components.
- 9) This module has its circuitry PCBs on the rear side and should be carefully handled in order to avoid being stressed.
- 10) Laminated film is attached to the module surface to prevent it from being scratched. Before use, peel the film off slowly, with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off 'dust' on the polarizer by using an ionized nitrogen gun.
- 11) Connect GND to 4 place of mounting holes to stabilize against EMI and external noise.
- 12) The high voltage portions on the backlight are very dangerous. Careless handling may lead to electrical shock.

PACKING FORM

- 1) Piling number of cartons: MAX 10
- 2) Package quantity in one carton: 20pcs
- 3) Carton size: 355 (W) X 282 (D) X 265 (H) mm
- 4) Total mass of 1 carton filled with full modules: 7.0kg

OTHERS

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

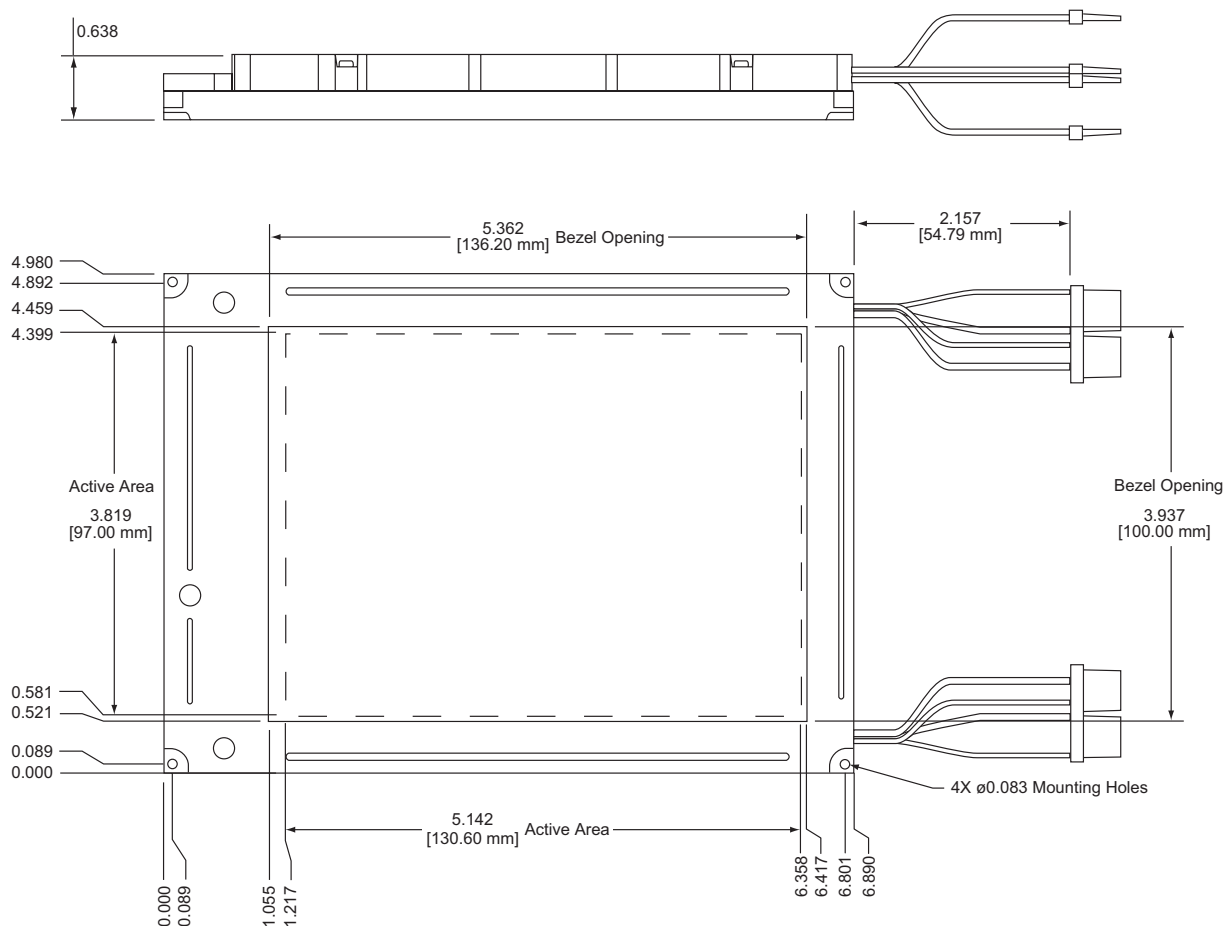
EXCHANGE OF LAMPS

This must be action must be performed by WEDC.

RELIABILITY TEST ITEMS

No.	Test item	Conditions	
1	High Temperature Storage Test	Ta=70°C	240h
2	Low Temperature Storage Test	Ta=25°C	240h
3	High Temperature & High Humidity Operation Test	Ta=40°C, 95%RH (No Condensation)	240h
4	High Temperature Operation Test	Ta=55°C	240h
5	Low Temperature Operation Test	Ta=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 :3 hours (1 hour for each direction of X,Y,Z)
7	Shock Test (Non-Operating)	Max. gravity Pulse width Direction	:490m/s ² :11ms, half sine wave :±X, ±Y, ±Z (once for each direction.)

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- | | | |
|------------------------------|-------------|------------|
| 1) TOLERANCE | X-DIRECTION | A:4×12±0×8 |
| 2) TOLERANCE | X-DIRECTION | B:1×52±0×8 |
| 3) TOLERANCE | Y-DIRECTION | C:1×52±0×8 |
| 4) TOLERANCE | Y-DIRECTION | D:1×52±0×8 |
| 5) OBLIQUITY OF DISPLAY AREA | | IE-F1<0×8 |

Notes:

- 1) Unspecified tolerance to be ±0.5.
- 2) Floating of PWB and chassis are excluded from module thickness.
- 3) Diameter of mounting boss shall be the range of 3.5mm to 4mm. (center of oval hole)

Original specifications created by Sharp.