



ENH104V2-380/450/600 Color TFT-LCD Module Features

GENERAL DESCRIPTION

Panelview provides optically enhanced solutions to the standard Optrex AA104VB05 color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module. The first enhancement is an index matching (IM) film lamination to the front surface of the display polarizer. The IM film is a contrast enhancement benefit and 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 third enhancement is the incorporation of an enhanced light guide (ELG) to improve brightness by up to 35%. The resultant brightness levels are shown in the Specifications below.

The module is composed of an LCD panel, driver ICs, control circuit, and backlight unit.

By applying 6 bit digital data 640 x 480, 260K-color images are displayed on the 10.4" diagonal screen.

Input power voltage is single 3.3 / 5.0V for LCD driving. Both 3.3V-CMOS and 5.0V-CMOS level voltage are acceptable for logic input voltage.

Inverter for backlight is not included in this module. General specifications are summarized in the following table:

SPECIFICATIONS

ITEM	SPECIFICATION
Display Area (mm)	211.2 (H) x 158.4 (V) (10.39-inch diagonal)
Number of Dots	640 x 3 (H) x 480 (V)
Pixel Pitch (mm)	0.33 (H) x 0.33 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	normally white
Number of Color	260 K
Wide Viewing Angle Technology	Optical compensation film
Optimum Viewing Angle (Contrast ratio)	12 o'clock
Brightness (cd/m ²)	
ENH104V2-380 (IM only)	380
ENH104V2-450 (IM, RP)	450
ENH104V2-600 (IM, RP, ELG)	600
Module Size (mm)	243.0 (W) x 181.6 (H) x 12.2 (D)
Module Mass (g)	530
Backlight Unit	CCFL, 2-tubes, replaceable
Surface Treatment	IM/Clear (glossy) or IM/110 and hardcoat 3H

Characteristic value without any note is typical value.

The LCD product described in this specification is designed and manufactured for the standard use in office automation equipment, instrumentation, communication equipment, automation, point of sale, etc.

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.

ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT
Power Supply Voltage for LCD	V _{CC}	-0.3	6.5	V
Logic Input Voltage	V _I	0	6.5	V
Lamp Voltage	V _L	0	2000	V _{rms}
Lamp Current	I _L	0	10.0	mA _{rms}
Lamp Frequency	FL	—	80	kHz
Operation Temperature (1)	T _{OP}	0	50	°C
Storage Temperature (1)	T _{STG}	-20	60	°C

Note 1. T_{OP}, T_{STG} ≤ 40°C : 90%RH max. without condensation

T_{OP}, T_{STG} > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

Original specifications created by Sharp.



ELECTRICAL CHARACTERISTICS

TFT- LCD AMBIENT TEMPERATURE : TA = 25°C

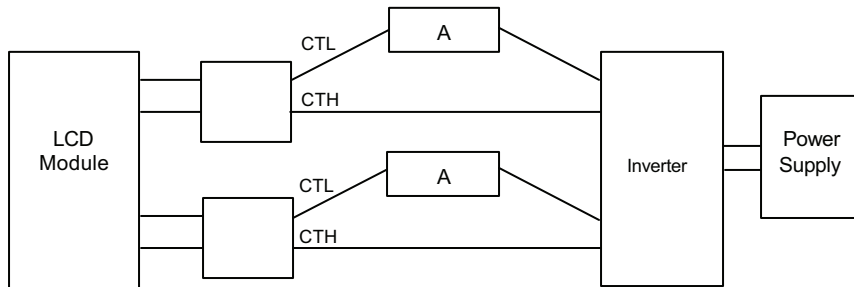
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply	3.3 V powered	V _{CC}	3.0	3.3	3.6	V	(A), (D)
Voltage for LCD	5.0 V powered	V _{CC}	4.75	5.0	5.25	V	(A), (D)
Power Supply	3.3 V powered	I _{CC}	–	220	380	mA	V _{CC} =3.3 V (B)
Current for LCD	5.0 V powered	I _{CC}	–	150	280	mA	V _{CC} =5.0 V (B)
Permissible Input Ripple Voltage		V _{RP}	–	–	100	mVp-p	V _{CC} =+3.3 V/5.0 V
Logic Input Voltage	High	V _{IH}	2.0	–	5.25	V	
	Low	V _{IL}	0	–	0.8	V	

BACKLIGHT TA=25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Lamp Voltage		V _L	–	580	–	V _{rms}	IL=6.0mArms
Lamp Current		I _L	3.0	6.0	7.0	mArms	(1)
Lamp Frequency		F _L	40	–	80	kHz	(2)
Starting Lamp Voltage	Ta=25°C	V _S	810	–	–	V _{rms}	
	Ta=0°C		1000	–	–	V _{rms}	
Lamp Life Time	IL=3.0mArms	L _T	50000	50000	–	h	(3), (4)
	IL=6.0mArms		40000	50000	–	h	
	IL=7.0mArms		30000	40000	–	h	

Notes:

1. Lamp Current measurement method (The current meter is inserted in low voltage line.)



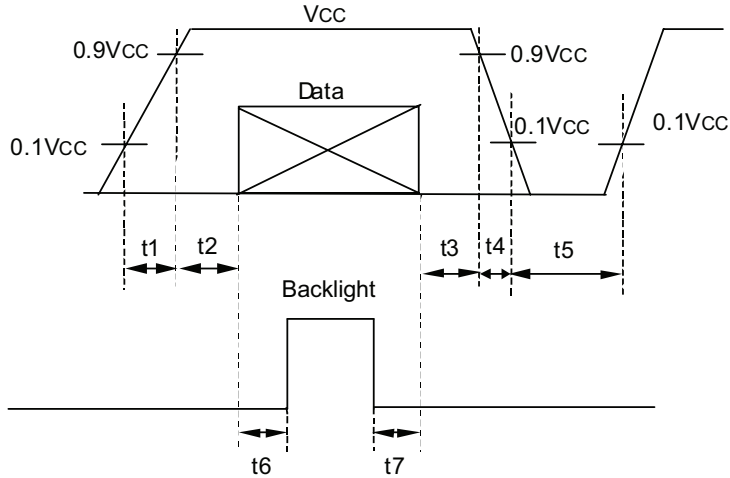
- Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.
- Lamp life time is defined as the time either when the brightness becomes 50% of the initial value, or when the starting lamp voltage does not meet the value specified in this table.
- The life time of the backlight depends on the ambient temperature. The life time will decrease under low/high temperature.



Notes:

A. Power and signals sequence:

- $t1 \leq 10 \text{ ms}$ $400 \text{ ms} \leq t5$
- $0 < t2 \leq 50 \text{ ms}$ $200 \text{ ms} \leq t6$
- $0 < t3 \leq 50 \text{ ms}$ $0 \leq t7$
- $0 < t4 \leq 50 \text{ ms}$



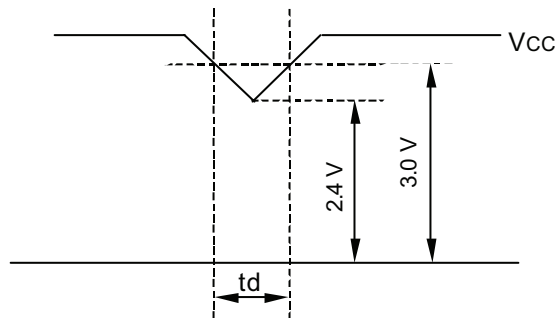
Data: RGB DATA, DCLK, HD, VD, DENA

Vcc-dip conditions:

(a) 3.3 V powered

1. When $2.4 \text{ V} \leq V_{cc} < 3.0 \text{ V}$, $t_d \leq 10 \text{ ms}$
2. When $V_{cc} < 2.4 \text{ V}$

Vcc-dip conditions should also follow the power and signals sequence.

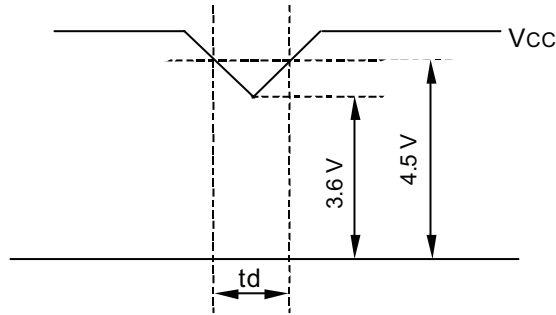




(b) 5.0 V powered

1. When $3.6\text{ V} \leq V_{CC} < 4.5\text{ V}$, $t_d \leq 10\text{ ms}$
2. When $V_{CC} < 3.6\text{ V}$

V_{CC}-dip conditions should also follow the power and signals sequence.



B) Typical current condition:

64- gray- bar-pattern

480 line mode

$V_{CC} = + 3.3/5.0\text{ V}$, $f_H=31.6\text{kHz}$, $f_V=60\text{Hz}$, $f_{CLK}= 25\text{MHz}$



INTERFACE PIN CONNECTION

CN 1(INTERFACE SIGNAL)

USED CONNECTOR: DF9B-31P-1V(HIROSE)/CORRESPONDING CONNECTOR: DF9B-31S-1V(HIROSE)

Pin No.	Symbol	Function
1	GND	
2	DCLK	Clock signal for sampling catch data signal
3	HD	Horizontal sync signal
4	VD	Vertical sync signal
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	DENA	Data enable signal(to settle the viewing area)
28	VCC	3.3 / 5.0 V Power Supply
29	VCC	3.3 / 5.0 V Power Supply
30	TEST	This pin should be open. Test signal output for only internal test use.
31	SC	Scan direction Control. (GND or Open:Normal, High:Reverse)

Notes:

1. The shielding case is connected with GND
2. See; Timing Chart (p. 7)

CN 2 , CN 3 (BACKLIGHT)

BACKLIGHT-SIDE CONNECTOR: BHR-02(8.0)VS-1N(JST)/INVERTER-SIDE CONNECTOR: SM02(8.0)B-BHS(JST)

Pin No.	Symbol	Function
1	CTH	VBLH High Voltage
3	CTL	VBLL Low Voltage

Note
VBLH-VBLL=VL



INTERFACE TIMING

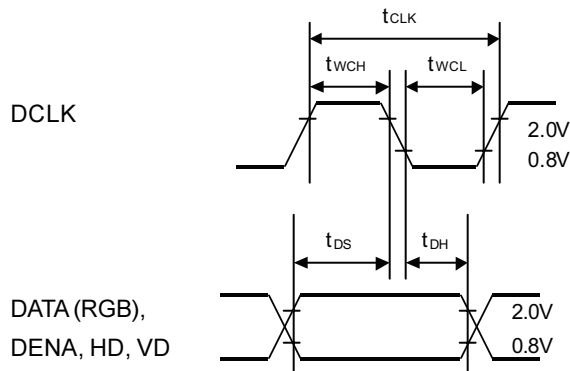
TIMING SPECIFICATIONS

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT
DCLK (1) (4)	Frequency	f_{CLK}	—	25	29	MHz
	Period	t_{CLK}	34.5	40	—	ns
	Low Width	t_{WCL}	12	—	—	ns
	High Width	t_{WCH}	12	—	—	ns
DATA (1) (R,G, B,DENA HD, VD)	Set up time	t_{DS}	5	—	—	ns
	Hold time	t_{DH}	5	—	—	ns
DENA (3)	Horizontal Active Time	t_{HA}	640	640	640	tCLK
	Horizontal Front Porch	t_{HFP}	10	16	—	tCLK
	Horizontal Back Porch	t_{HBP}	2	144	—	tCLK
	Vertical Active Time	t_{VA}	480	480	480	tH
	Vertical Front Porch	t_{VFP}	1	12	—	tH
	Vertical Back Porch	t_{VBP}	2	33	—	tH
HD (2) (4)	Frequency	f_H	27	31.6	38	kHz
	Period	t_H	26.3	31.6	37.0	μ s
	Low Width	t_{WHL}	5	96	—	tCLK
VD (2)	Frequency	f_V	55	60	70	Hz
	Period	t_V	14.3	16.7	18.2	ms
	Low Width	t_{WVL}	3	—	—	tH

Note:

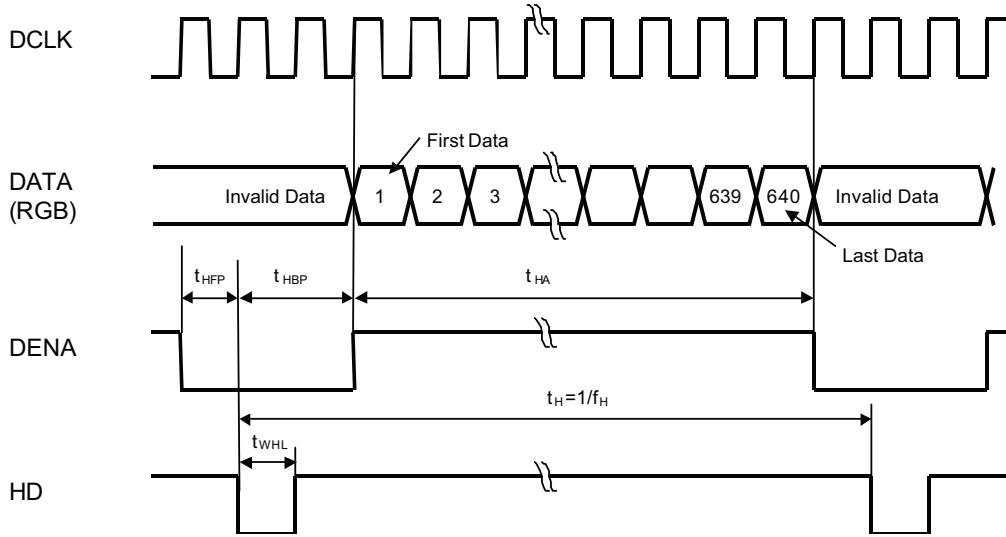
1. DATA is latched at fall edge of DCLK in this specification.
2. Polarities of HD and VD are negative in this specification.
3. DENA (Data Enable) should always be positive polarity as shown in the timing specification.
4. DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.

PIXEL TIMING CHART

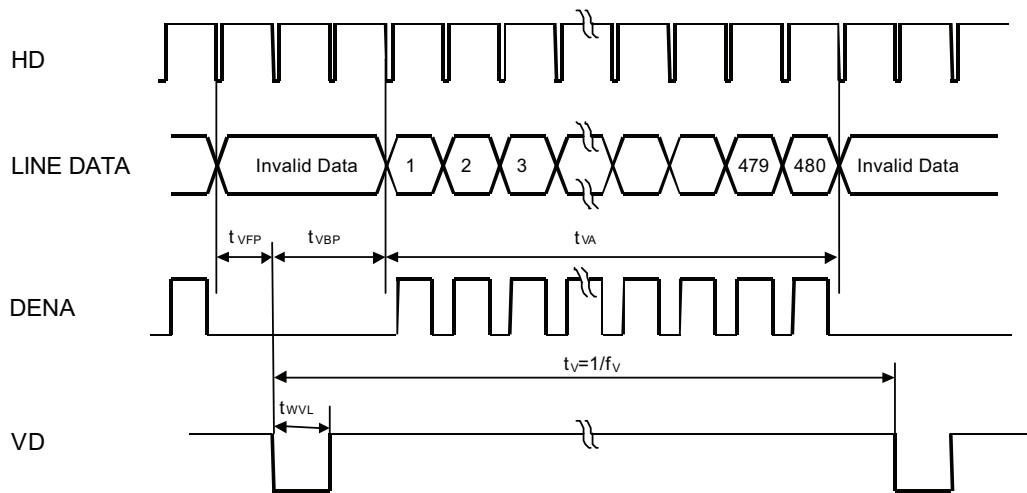




HORIZONTAL TIMING CHART



VERTICAL TIMING CHART





COLOR DATA ASSIGNMENT

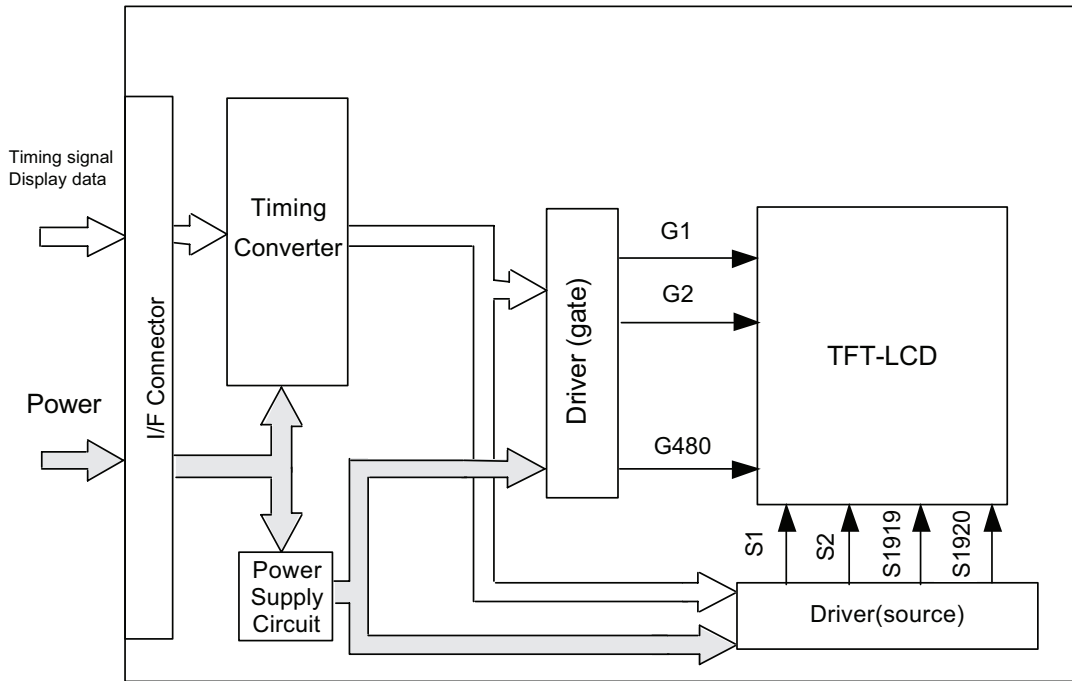
COLOR	INPUT DATA	R DATA					G DATA					B DATA							
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	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
RED	RED (0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED (2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED (2)	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN (62)	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN (63)	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE (0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE (62)	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE (63)	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1

Notes:

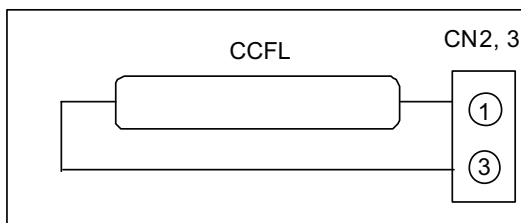
1. Definition of gray scale
Color (n)...n indicates gray scale level. Higher n means brighter level.
2. Data 1: High, 0: Low



BLOCK DIAGRAM



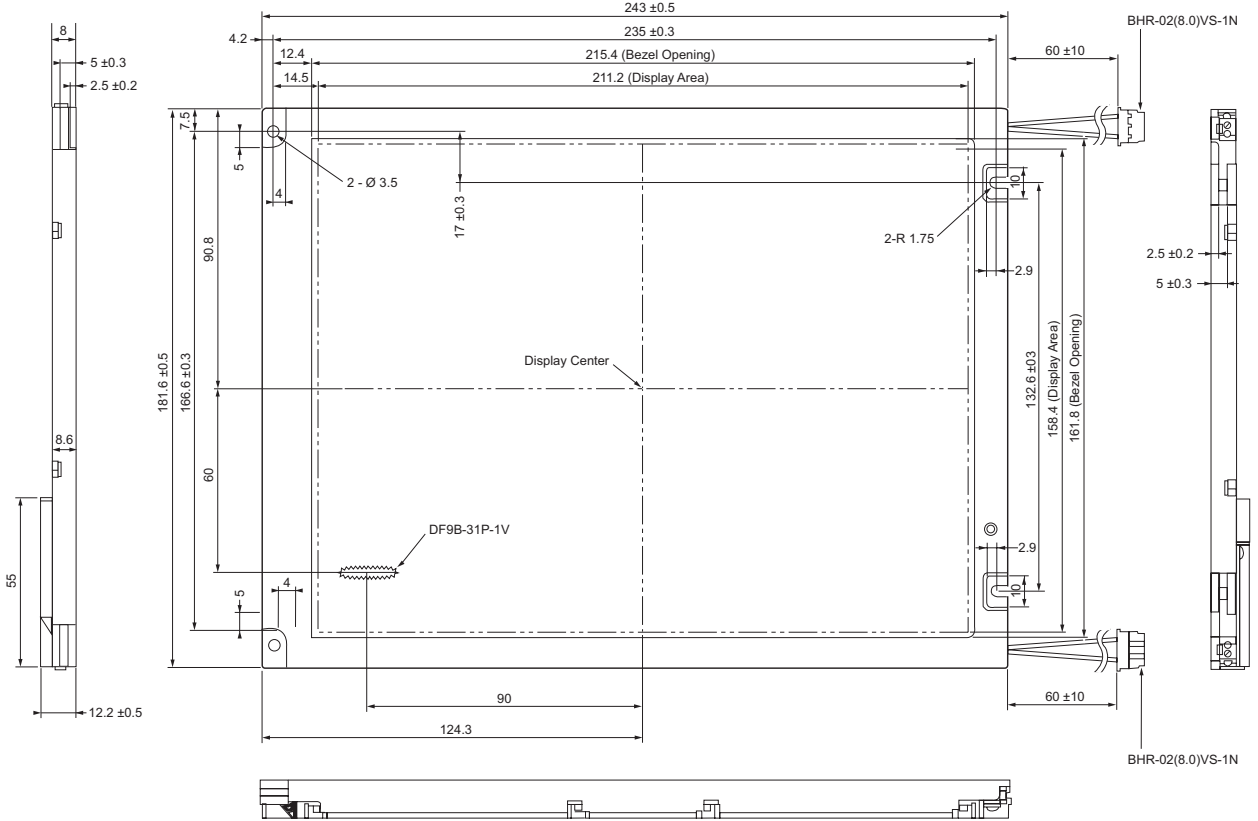
BACKLIGHT



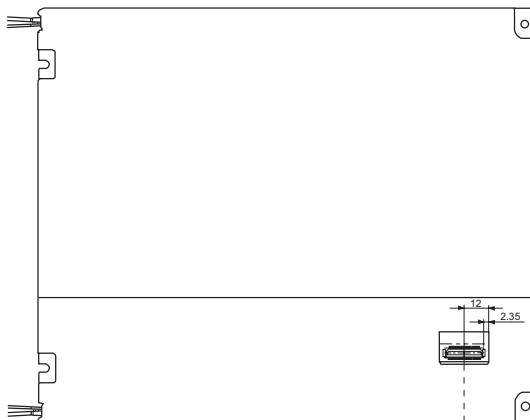


MECHANICAL SPECIFICATIONS

FRONT VIEW



REAR VIEW



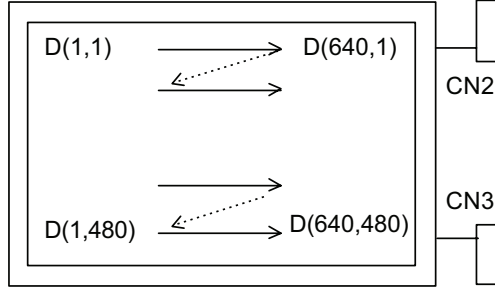
Note: Tolerance is $\pm 0.5\text{mm}$ unless noted.

Original specifications created by Sharp.

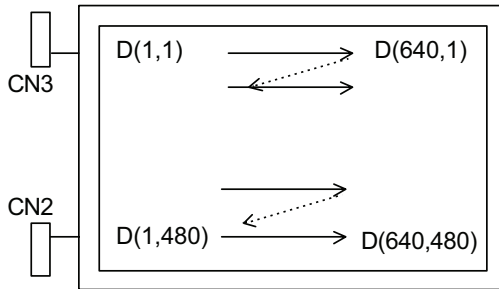


SCANNING DIRECTION

SC : High



SC : GND or Open





OPTICAL CHARACTERISTICS

TA=25°C, VCC=3.3 / 5.0 V, INPUT SIGNALS: TYP. VALUES SHOWN IN SECTION 5

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	Remarks	
Contrast Ratio	CR	$\theta = \phi = 0^\circ$	150	300	—	—	1, 3	
Luminance ENH104V2-380 (IM only) ENH104V2-450 (IM, RP) ENH104V2-600 (IM, RP, ELG)	Lw	$\theta = \phi = 0^\circ$		380 450 600		cd/m2	2, 3	
Response Time	tr	$\theta = \phi = 0^\circ$	—	15	—	ms	3, 4	
	tf	$\theta = \phi = 0^\circ$	—	35	—	ms	3, 4	
Viewing Angle	Horizontal	$CR \geq 10$	—	-60~60	—	°	3	
	Vertical		—	-45~55	—	°	3	
Color Coordinates	Red	Rx	$\theta = \phi = 0^\circ$	0.54	0.57	0.60	—	3
		Ry		0.30	0.33	0.36		
	Green	Gx		0.30	0.33	0.36		
		Gy		0.49	0.52	0.55		
	Blue	Bx		0.14	0.17	0.20		
		By		0.15	0.18	0.21		
	White	Wx		0.29	0.32	0.35		
		Wy		0.31	0.34	0.37		

Notes:

These items are measured using BM-5A(TOPCON) or LCD-7000(Otsuka Electronic) under the dark room condition (no ambient light).

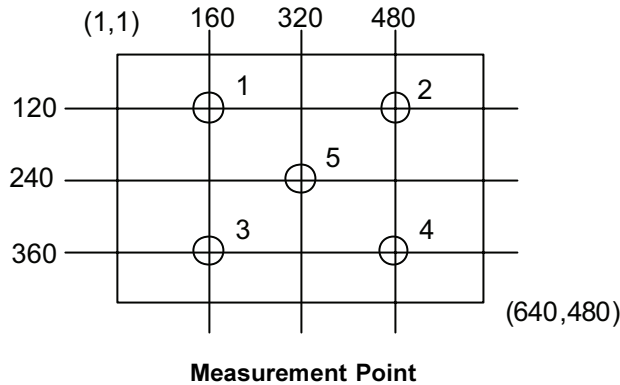
Condition: IL=6.0mArms, FL=55 kHz

1. Definition of Contrast Ratio

CR=ON (White) Luminance / OFF(Black) Luminance: average of 5 points

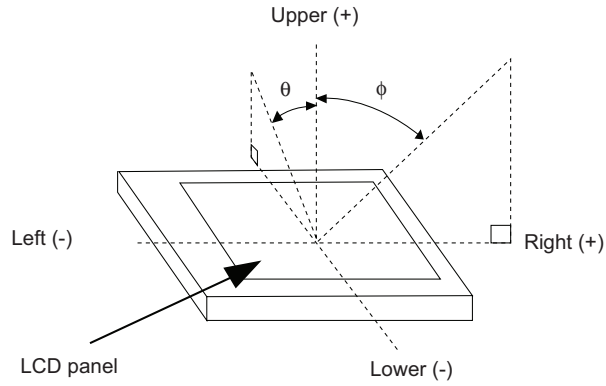
2. Definition of Luminance

Lw= ON (White) Luminance: average of 5 points

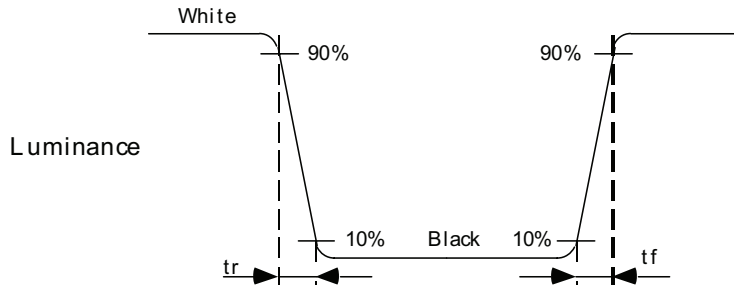




3. Definition of Viewing Angle (θ , ϕ)



4. Definition of Response Time





RELIABILITY TEST CONDITION

TEMPERATURE AND HUMIDITY

TEST ITEM	CONDITIONS
HIGH TEMPERATURE HIGH HUMIDITY OPERATION	40°C, 90%RH, 240 h
HIGH TEMPERATURE STORAGE	60°C, 96 h
LOW TEMPERATURE STORAGE	-20°C, 96 h
THERMAL SHOCK(NON-OPERATION)	BETWEEN -20°C (1h) and 60°C(1h), 5 CYCLES

SHOCK & VIBRATION

ITEM	CONDITIONS
SHOCK (NON-OPERATION)	Shock level: 1470m/s ² (150G) Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axis for a total of six shock inputs
VIBRATION (NON-OPERATION)	Vibration level: 9.8m/s ² (1.0G) Waveform: sinusoidal Frequency range: 5 to 500Hz Frequency sweep rate: 0.5 octave /min Duration: one sweep from 5 to 500 to 5Hz in each of three mutually perpendicular axis(total 3 hours)

JUDGMENT STANDARD

The judgment of the above tests should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect.

Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.



HANDLING PRECAUTIONS FOR TFT-LCD MODULE

ASSEMBLY PRECAUTION

- a. Use the mounting hole on the module when installing and do not bend or wrench the LCD during assembly. Do not drop, bend or twist LCD module while handling.
- b. Design display housing in accordance with the following guide lines:
 - (a) Housing case must be designed carefully so as not to put stress on all 4 LCD sides and not to twist the module.
 - (b) Keep sufficient clearance between the LCD module back surface and housing when the LCD module is mounted. Approximately 1.0mm of the clearance in the design is recommended taking into account the tolerance of the LCD module thickness and mounting structure height on the housing.
 - (c) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, sufficient clearance is still required, such as 0.5mm. This clearance is especially to be considered when the additional parts are implemented for EMI countermeasure.
 - (d) Design the inverter location and connector position carefully so as not to cause stress to the lamp cable, or interface the LCD module by the lamp cable.
 - (e) Keep sufficient clearance between the LCD module and the others parts, such as the inverter so as not to interfere with the LCD module. Approximately 1.0mm of the clearance in the design is recommended.
- c. Do not push or scratch LCD panel surface with anything hard. Avoid touching the LCD surface with bare hands. (the Polarizer film surface of the LCD panel can be easily damaged.)
- d. Do not allow contact between any parts with the rear side such as source TCP, gate TCP, control circuit board and FPCs when handling the LCD module. If contact with the rear side is unavoidable, handle the LCD module with care not to damage them.
- e. Use absorbent cotton or soft cloth for cleansing the LCD panel if soiled.
- f. Avoid liquid contact on the LCD panel surface, because damage could occur such as panel surface

variation and color change.

- g. Do not take the LCD module apart and reconstruct it, as this may affect the performance of the module.
- h. Avoid handling the metal frames with bare hands or soiled gloves.
- i. Take care when handling the lead wire of the backlight so that it is not pulled on when connecting to the inverter.
- j. Connect the metal frame of LCD module to GND to minimize the effect of external noise and EMI.

OPERATING PRECAUTIONS

- a. Shut down the power supply before connecting and disconnecting signal input cable.
- b. Do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If changed, the LCD may not satisfy the characteristics specification.
- c. The LCD backlight takes longer to become stable of radiation characteristics in low temperatures than in room temperature.
- d. Condensation might occur on the surface and inside of LCD module if there is a sudden change of ambient temperature.
- e. Do not display the same pattern for a long period of time as image retention may occur.

PRECAUTIONS WITH ELECTROSTATICS

- a. Care should be exercised by making sure that one is grounded when handling.
- b. Remove the protective film slowly from the LCD module surface to prevent the occurrence of electrostatic.



STORAGE PRECAUTIONS

- a. Do not store LCDs in a high humidity and high temperature environment such as 60°C 90%RH.
- b. Do not store the LCDs in a low temperature environment below -20°C.

SAFETY PRECAUTIONS

- a. When disposing of damaged or unnecessary LCDs, it is recommended to crush the LCDs rinse the pieces with solvents such as acetone and ethanol, which should later be burned.
- b. Wash hands off thoroughly with soap and water if they come in contact with the liquid from a leaking glass cell.
- c. Be sure to turn off the power supply when inserting or disconnecting the cable.
- d. Inverter should be designed carefully so as not to keep working in case of detecting over current or open circuit on the lamp.

OTHERS

- a. A strong incident light into LCD panel might cause display characteristics changing inferior because of polarizer film, color filter, and other materials becoming inferior. Do not expose LCD module to direct sunlight and strong UV rays.
- b. Pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- c. Use the following packing instructions;
 - (a) The packing box and inner case for the LCD are designed to protect the LCDs from damage and scratching during transportation. Do not open the LCD boxes before use.
 - (b) Do not pile more than 5 boxes high, and do not store upside-down.
 - (c) Keep the LCD boxes from being vibrated or thrown.
 - (d) The packing box and inner case for the LCDs are made of cardboard, therefore avoid contact with water or high humidity.