TITLE : MV238QHB-N20

Product Specification Rev. P0

BEIJING BOE Display TECHNOLOGY

SPEC. NUMBER	PRODUCT GROUP	Rev. P0	ISSUE DATE	PAGE
S8-64-8A-158/O	TFT-LCD		2018.10.11	1 OF 28

BOE	PRODUCT GROUP	REV	ISSUE DATE
	Customer SPEC	Rev. P0	2018.10.11

REVISION HISTORY

REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2018.10.11	Bai Zhidi

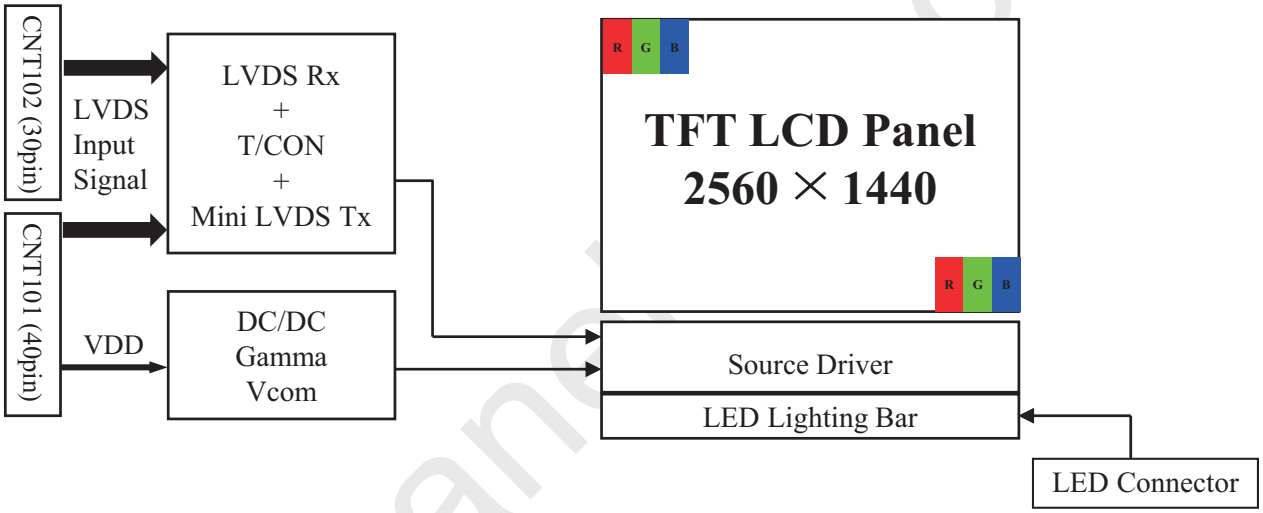
Contents

No.	Item	Page
1.0	General Description	4
2.0	Absolute Maximum Ratings	6
3.0	Electrical Specifications	7~8
4.0	Optical Specifications	9~10
5.0	Interface Connection	12~15
6.0	Signal Timing Specifications	16~17
7.0	Signal Timing Waveforms of Interface Signal	18~19
8.0	Input Signals, Display Colors & Gray Scale of Colors	20
9.0	Power Sequence	21
10.0	Mechanical Characteristics	22
11.0	Reliability Test	23
12.0	Handling& Cautions	24
13.0	Product Serial Number	25
14.0	Packing	26~27
15.0	Appendix	28~31

1.0 GENERAL DESCRIPTION

1.1 Introduction

MV238QHB-N20 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 23.8 inch diagonally measured active area with FHD resolutions (2560 horizontal by 1440 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors. The TFT-LCD panel used for this module is adapted for a low reflection and higher color type.



1.2 Features

- LVDS Interface with 2 pixel / clock
- High-speed response
- 6-bit (Hi-FRC) color depth, display 16. 7M colors
- High luminance and contrast ratio, low reflection and wide viewing angle
- DE (Data Enable) only
- RoHS/Halogen Free
- TCO 7.0 , ES 7.0 compliant
- Gamma Correction
- Reverse type

1.3 Application

- Desktop Type of PC & Workstation Use
- Slim-Size Display for Stand-alone Monitor
- Display Terminals for Control System
- Monitors for Process Controller

1.4 General Specification

The followings are general specifications at the model MV238QHB-N20.

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	526.848(H) × 296.352(V)	mm	
Number of pixels	2560(H) ×1440(V)	pixels	
Pixel pitch	0.2058(H) ×0.2058(V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M	colors	
Display mode	Normally Black		
Dimensional outline	534.04 (H)×307.76(V)	mm	Detail refer to drawing
Weight	515g(Typ.)	g	
Surface Treatment	Haze 25%, 3H		

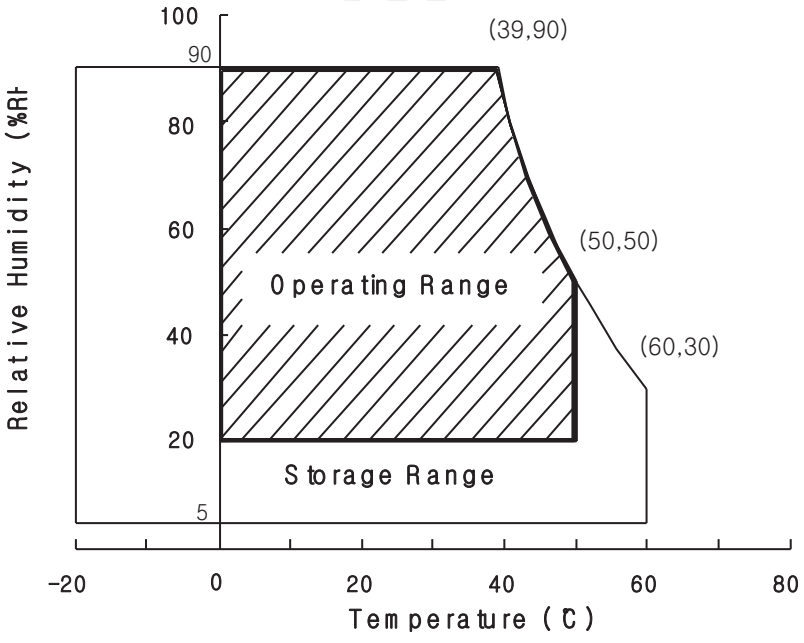
2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

< Table 2. Absolute Maximum Ratings> [VSS=GND=0V]

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	6.0	V	Ta = 25 ℃
Logic Supply Voltage	V_{IN}	VSS-0.3	V_{DD}+0.3	V	
Operating Temperature	T_{OP}	0	+50	℃	1)
Storage Temperature	T_{ST}	-20	+60	℃	1)

Note : 1) Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ^{O}C max. and no condensation of water.



Note : 2) Panel Surface Temperature should be Min. 0^{O}C and Max. +65^{O}C under the VDD = 5.0V, Frame rate = 60Hz,25^{O}C ambient Temp. no humidity control and LED string current is typical value.

3.0 ELECTRICAL SPECIFICATIONS

3.1Electrical Specifications

< Table 3. Electrical specifications > [Ta =25±2 ℃]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	4.5	5.0	5.5	V	Note1
Power Supply Current	I_{DD}	-	900	1600	mA	
In-Rush Current	I_{RUSH}	-	2.0	3.0	A	Note 2
Permissible Input Ripple Voltage	V_{RF}	-	-	300	mV	Note1,3
High Level Differential Input Threshold Voltage	V_{IH}	-	-	+100	mV	
Low Level Differential Input Threshold Voltage	V_{IL}	-100	-	-	mV	
Differential input voltage	$\|V_{ID}\|$	200	-	600	mV	
Differential input common mode voltage	Vcm	1.0	1.2	1.5		V_{IH}=100mV, V_{IL}=-100mV
Power Consumption	P_D	-	4.5	8.0	W	
	P_{BL}	-	16.6	17.5	W	Note 4
	P_{total}	-			W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VDD=5.0V, Frame rate=75Hz
Clock frequency = 75.6 MHz. Test Pattern of power supply current
a) Typ : Color Test
b) Max : Vertical SubLine 255

2. Duration of rush current is about 2 ms and rising time of VDD is 520 µs ± 20 %
3. Ripple Voltage should be covered by Input voltage Spec.
4. Calculated value for reference (Input pins*VPIN ×IPIN) excluding inverter loss.

4.0 OPTICAL SPECIFICATION

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and **TOPCONE PR730**) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to $\theta_{Ø=0}$ (=θ_3) as the 3 o'clock direction (the "right"), $\theta_{Ø=90}$ (= θ_{12}) as the 12 o'clock direction ("upward"), $\theta_{Ø=180}$ (= θ_9) as the 9 o'clock direction ("left") and $\theta_{Ø=270}$(= θ_6) as the 6 o'clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be 5.0V +/-10% at 25°C. Optimum viewing angle direction is 6 'clock.

4.2 Optical Specifications

[VDD = 5.0V, Frame rate = 60Hz, Clock = 60.4MHz, **I_{BL} = 340mA,** Ta =25±2 ℃]

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	80	89	-	Deg.	Note 1
		Θ_9		80	89	-	Deg.	
	Vertical	Θ_{12}		80	89	-	Deg.	
		Θ_6		80	89	-	Deg.	
Luminance Contrast ratio		CR	Θ = 0° (Center) Normal Viewing Angle	700	1000			Note 2
Cell Transmittance		Tr		-	4.8	-	%	Note 3
Luminance of White		Y_w		240	300		cd/m^2	Note 4
White luminance uniformity		ΔY		75	-		%	Note 5
Reproduction of color	White	W_x		0.283	0.313	0.343	-	Note 6
		W_y		0.299	0.329	0.359	-	
	Red	R_x		0.611	0.641	0.671	-	
		R_y		0.298	0.328	0.358	-	
	Green	G_x		0.274	0.304	0.334	-	
		G_y		0.585	0.615	0.645	-	
	Blue	B_x		0.118	0.148	0.178	-	
		B_y		0.032	0.062	0.092	-	
Response Time	GTG	T_g			14	20	ms	Note 7
Cross Talk		CT		-	-	2.0	%	Note 8

Note :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.
2. Contrast measurements shall be made at viewing angle of θ= 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Luminance of LCD module shall be made without signal input. Cell transmittance is defined mathematically, BLU provided by BOEDT.

$$\text{Transmittance} = \frac{\text{Luminance of LCD Module}}{\text{Luminance of BLU}}$$

4. Center Luminance of white is defined as the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.
5. The White luminance uniformity on LCD surface is then expressed as :
   ΔY = (Minimum Luminance of 9points / Maximum Luminance of 9points) * 100
   (See FIGURE 2 shown in Appendix).
6. The color chromaticity coordinates specified in Table 4. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.
7. Response time Tg is the average time required for display transition by switching the input signal as below table and is based on Frame rate fV =60Hz to optimize.
   Each time in below table is defined as Figure 3and shall be measured by switching the input signal for "any level of gray(bright)"and "any level of gray(dark)".
8. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (Y_A) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (Y_B) of that same area when any adjacent area is driven dark. (See FIGURE 4 shown in Appendix).

5.0 INTERFACE CONNECTION.

5.1 Electrical Interface Connection

- CN101 Module Side Connector : PM.LVS.08115F4001or Equivalent

Pin No	Symbol	Function	Pin No	Symbol	Function
1	CLV0-	Negative Transmission data of Pixel 0	**21**	DLV2+	Positive Transmission data of Pixel 2
2	CLV0+	Positive Transmission data of Pixel 0	**22**	GND	Power Ground
3	CLV1-	Negative Transmission data of Pixel 1	**23**	DLVC-	Negative Transmission Clock
4	CLV1+	Positive Transmission data of Pixel 1	**24**	DLVC+	Positive Transmission Clock
5	CLV2-	Negative Transmission data of Pixel 2	**25**	GND	Power Ground
6	CLV2+	Positive Transmission data of Pixel 2	**26**	DLV3-	Negative Transmission data of Pixel 3
7	GND	Power Ground	**27**	DLV3+	Positive Transmission data of Pixel 3
8	CLVC-	Negative Transmission Clock	**28**	NC	No Connection
9	CLVC+	Positive Transmission Clock	**29**	NC	No Connection
10	GND	Power Ground	**30**	NC	No Connection
11	CLV3-	Negative Transmission data of Pixel 3	**31**	NC	No Connection
12	CLV3+	Positive Transmission data of Pixel 3	**32**	NC	No Connection
13	NC	No Connection	**33**	NC	No Connection
14	NC	No Connection	**34**	GND	Power Ground
15	GND	Power Ground	**35**	GND	Power Ground
16	DLV0-	Negative Transmission data of Pixel 0	**36**	VDD	Power Supply
17	DLV0+	Positive Transmission data of Pixel 0	**37**	VDD	Power Supply
18	DLV1-	Negative Transmission data of Pixel 1	**38**	VDD	Power Supply
19	DLV1+	Positive Transmission data of Pixel 1	**39**	VDD	Power Supply
20	DLV2-	Negative Transmission data of Pixel 2	**40**	VDD	Power Supply

5.0 INTERFACE CONNECTION.

5.2 Electrical Interface Connection

- CN102 Module Side Connector : UJU IS100-L30O-C23or Equivalent
  User Side Connector : JAE FI-X30H or Equivalent

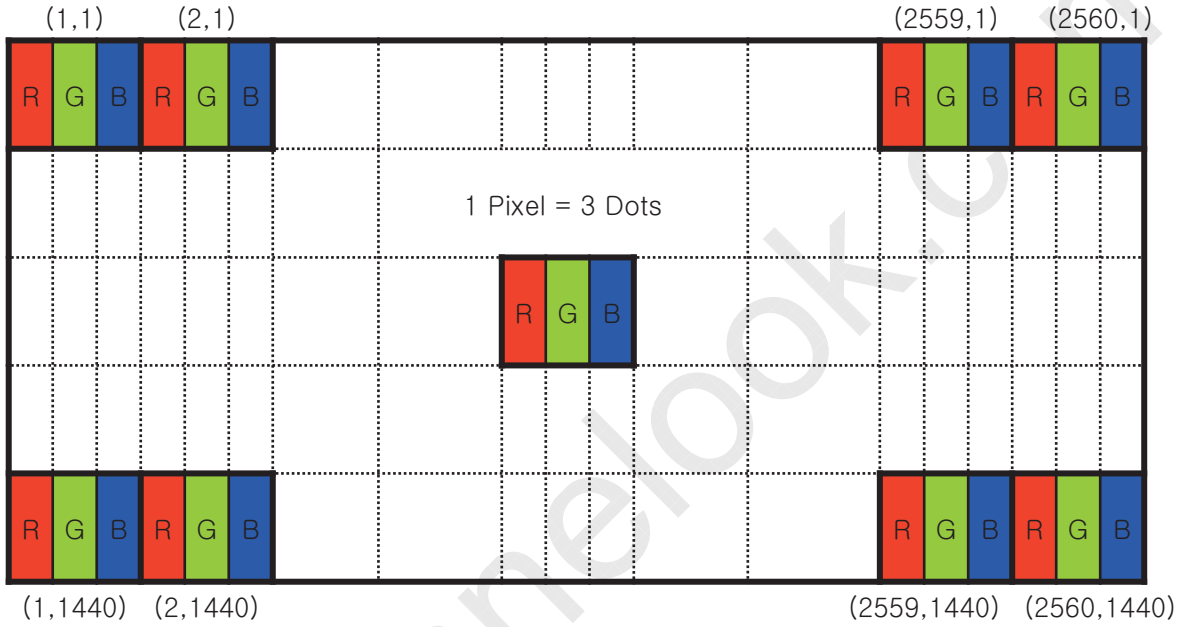
Pin No	Symbol	Function	Pin No	Symbol	Function
1	ALV0-	Negative Transmission data of Pixel 0	**16**	BLV0-	Negative Transmission data of Pixel 0
2	ALV0+	Positive Transmission data of Pixel 0	**17**	BLV0+	Positive Transmission data of Pixel 0
3	ALV1-	Negative Transmission data of Pixel 1	**18**	BLV1-	Negative Transmission data of Pixel 1
4	ALV1+	Positive Transmission data of Pixel 1	**19**	BLV1+	Positive Transmission data of Pixel 1
5	ALV2-	Negative Transmission data of Pixel 2	**20**	BLV2-	Negative Transmission data of Pixel 2
6	ALV2+	Positive Transmission data of Pixel 2	**21**	BLV2+	Positive Transmission data of Pixel 2
7	GND	Power Ground	**22**	GND	Power Ground
8	ALVC-	Negative Transmission Clock	**23**	BLVC-	Negative Transmission Clock
9	ALVC+	Positive Transmission Clock	**24**	BLVC+	Positive Transmission Clock
10	GND	Power Ground	**25**	GND	Power Ground
11	ALV3-	Negative Transmission data of Pixel 3	**26**	BLV3-	Negative Transmission data of Pixel 3
12	ALV3+	Positive Transmission data of Pixel 3	**27**	BLV3+	Positive Transmission data of Pixel 3
13	NC	No Connection	**28**	NC	No Connection
14	NC	No Connection	**29**	NC	No Connection (*Reserved for LCD manufacturer‘s use)
15	GND	Power Ground	**30**	NC	No Connection (*Reserved for LCD manufacturer‘s use)

5.2 LVDS Interface (Tx; THC63LVDF83A or Equivalent)

5.2.1 LVDS Interface

	Input Signal	Transmitter		Interface		MV238QHM-N20 (CN102)	Remark
		Pin No.	Pin No.	System (Tx)	TFT-LCD (Rx)	Pin No.	
LVDS	OR0	51	48 47	OUT0- OUT0+	RXO0- RXO0+	1 2	
	OR1	52					
	OR2	54					
	OR3	55					
	OR4	56					
	OR5	3					
	OG0	4					
	OG1	6	46 45	OUT1- OUT1+	RXO1- RXO1+	3 4	
	OG2	7					
	OG3	11					
	OG4	12					
	OG5	14					
	OB0	15					
	OB1	19					
	OB2	20	42 41	OUT2- OUT2+	RXO2- RXO2+	5 6	
	OB3	22					
	OB4	23					
	OB5	24					
	Hsync	27					
	Vsync	28					
	DE	30					
	MCLK	31	40 39	CLK OUT- CLK OUT+	RXO CLK- RXO CLK+	8 9	
	OR6	50	38 37	OUT3- OUT3+	RXO3- RXO3+	10 11	
	OR7	2					
	OG6	8					
	OG7	10					
	OB6	16					
	OB7	18					
	RSVD	25					

5.3 Data Input Format



Display Position of Input Data (V-H)

Notes : 1. Reverse Type, PCBA at the Bottom

6.0 SIGNAL TIMING SPECIFICATION

6.1 The MV238QHM-N20 is operated by the DE only.

Item	Symbols		Min	Typ	Max	Unit
DCLK	Period	tCLK	12.12	16.56	20.71	ns
	Frequency	-	48.3	60.4	82.5	MHz
Horizontal Display Term	Period	tHP	679	680	709	tCLK
	Horizontal Valid	tHV	640	640	640	tCLK
	Horizontal Blank	tHB	39	40	69	tCLK
	Frequency	fH	74	88.9	112	KHz
Vertical Display Term	Period	tVP	1452	1481	1550	tHP
	Vertical Valid	tVV	1440	1440	1440	tHP
	Vertical Blank	tVB	12	41	110	tHP
	Frequency	fV	48	60	75	Hz
LVDS Receiver clock	Input spread spectrum ratio	SSr	-3	-	+3	%

Note: The DCLK range at last line of V-blanking should be set in 0~987

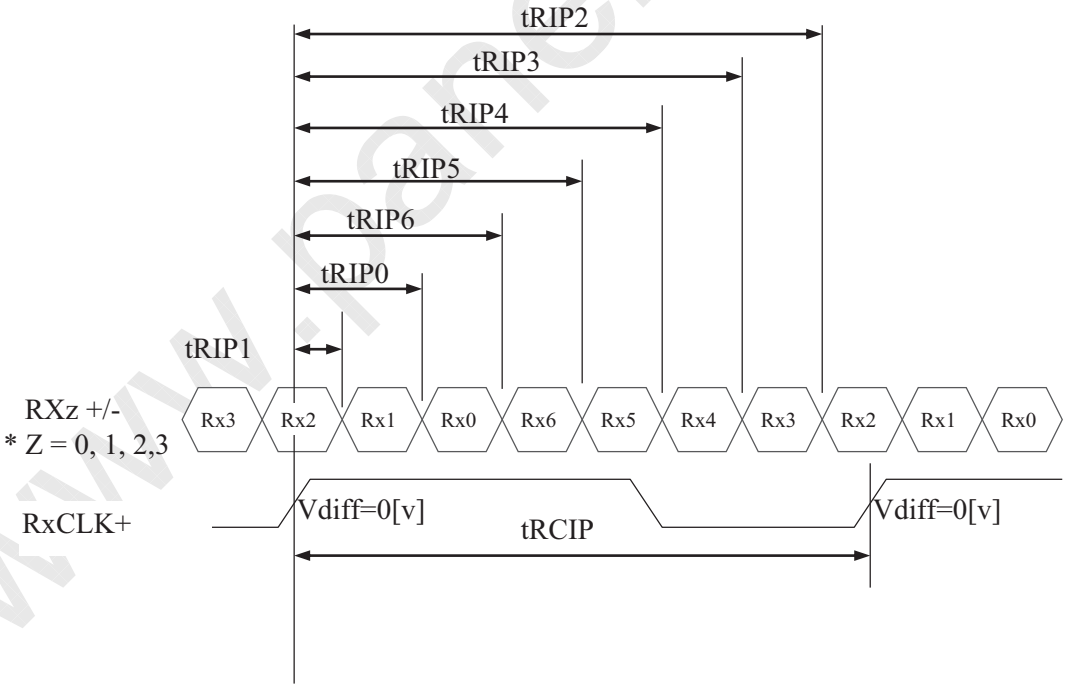
Note: The DCLK range at last line of V-blanking should be set in 0~987

6.2 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 4.

<Table 4. LVDS Rx Interface Timing Specification>

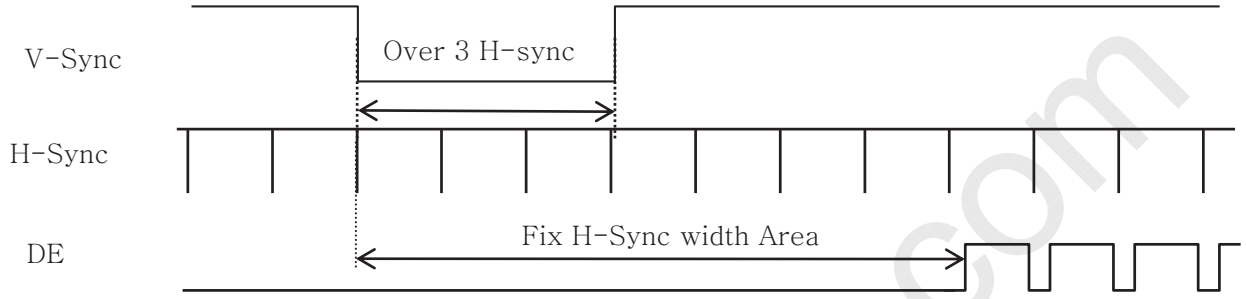
Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	12.12	16.56	20.71	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 ×tRCIP/7-0.4	2 ×tRCIP/7	2 ×tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 ×tRCIP/7-0.4	3 ×tRCIP/7	3 ×tRCIP/7+0.4	nsec	
Input Data 4	tRIP4	4 ×tRCIP/7-0.4	4 ×tRCIP/7	4 ×tRCIP/7+0.4	nsec	
Input Data 5	tRIP3	5 ×tRCIP/7-0.4	5 ×tRCIP/7	5 ×tRCIP/7+0.4	nsec	
Input Data 6	tRIP2	6 ×tRCIP/7-0.4	6 ×tRCIP/7	6 ×tRCIP/7+0.4	nsec	



* Vdiff = (RXz+)-(RXz-),…. ,(RXCLK+)-(RXCLK-)

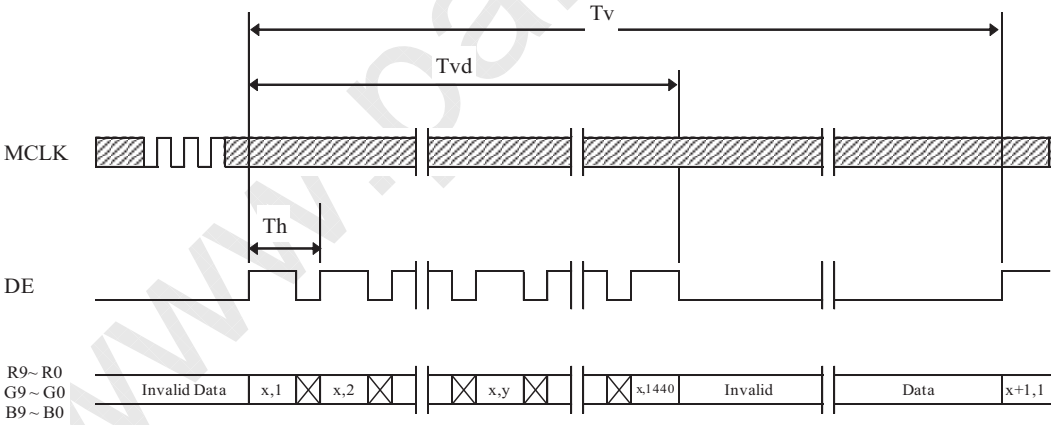
7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL

7.1 Sync Timing Waveforms

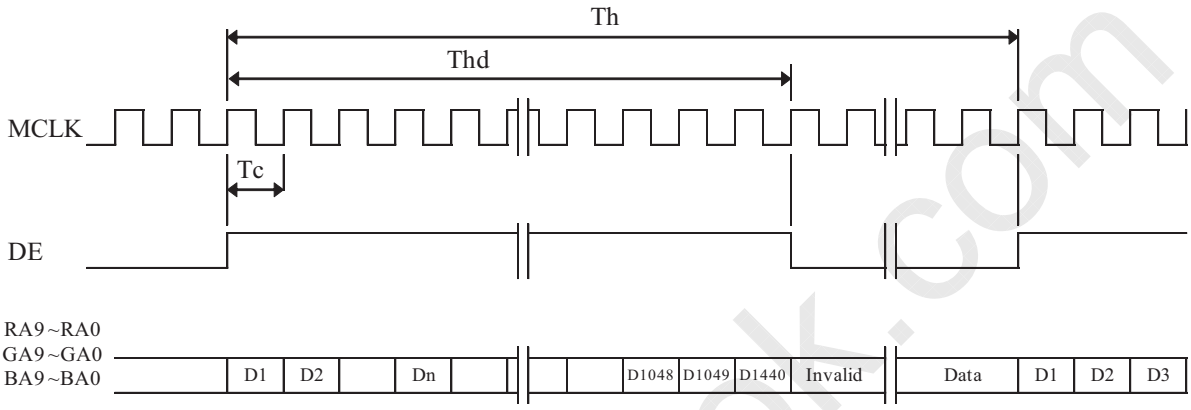


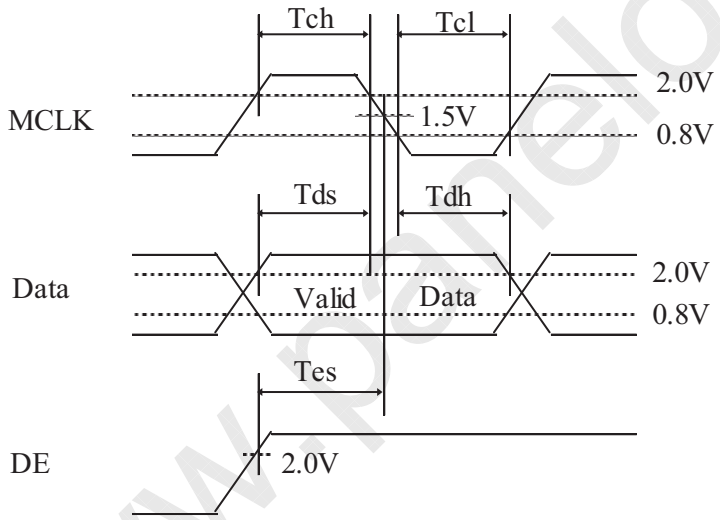
1) Need over 3 H-sync during V-Sync Low
2) Fix H-Sync width from V-Sync falling edge to first rising edge

7.2 Vertical Timing Waveforms



7.3 Horizontal Timing Waveforms



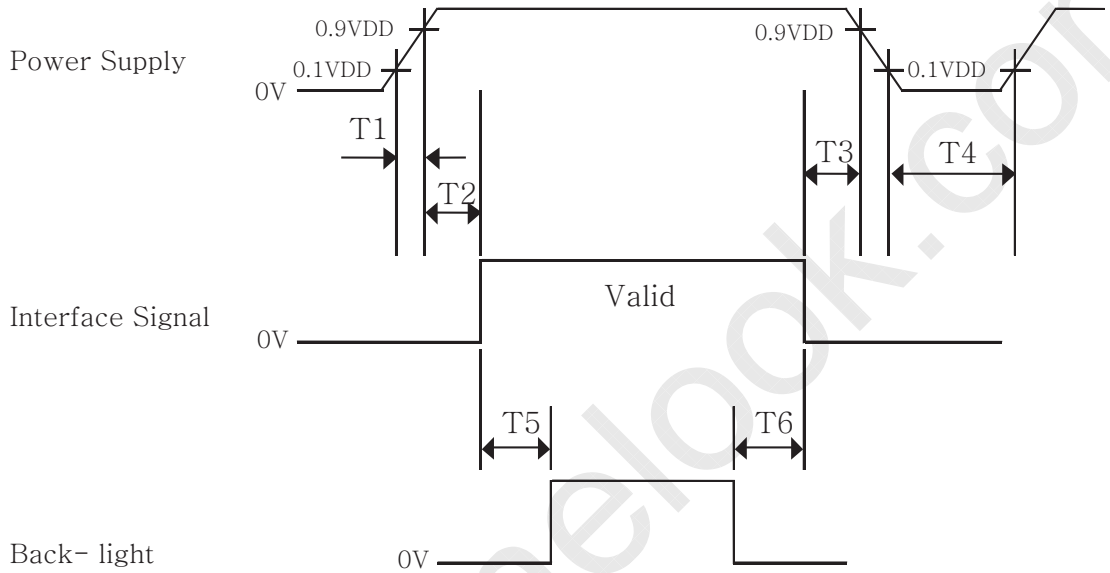


8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

Color & Gray Scale		RED DATA								GREEN DATA								BLUE DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	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	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1
Gray Scale of RED	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of GREEN	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of BLUE	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of WHITE	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

9.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below



- 0.5 ms ≤ T1 ≤ 10 ms
- 0 ≤ T2 ≤ 50 ms
- 0 ≤ T3 ≤ 50 ms
- 1 sec ≤ T4
- 200 ms ≤ T5
- 200 ms ≤ T6

Notes:

1. The above power sequence be satisfied at these case
   a. AC/DC Power On/Off
   b. Mode Change(Resolution, Frequency, Timing, Sleep Mode, Color Depth Change, etc.)
   If not to follow power sequence, these is a risk of abnormal display.
2. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
3. Do not keep the interface signal high impedance when power is on.
4. Back Light must be turn on after power for logic and interface signal are valid.

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 6 (located in Appendix) shows mechanical outlines for the model MV238FHM-N30. Other parameters are shown in Table 5.

<Table 5. Dimensional Parameters>

Parameter	Specification	Unit
Dimensional outline	534.04 (H)×307.76(V)	mm
Weight	515g(Typ.)	gram
Active area	526.848(H) ×296.352(V)	mm
Pixel pitch	0.2058(H) ×0.2058(V)	mm
Number of pixels	2560 (H)×1440 (V) (1 pixel = R + G + B dots)	pixels

10.2 Mounting

No Mounting

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an anti-glare coating to minimize reflection and a coating to reduce scratching.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50cm from the screen with an overhead light level of 350lux.

11.0 RELIABLITY TEST

The Reliability test items and its conditions are shown in below.

<Table 6. Reliability Test Parameters >

No	Test Items	Conditions
1	High temperature storage test	Ta = 60 ℃, 240 hrs
2	Low temperature storage test	Ta = -20 ℃, 240 hrs
3	High temperature & high humidity operation test	Ta = 50 ℃, 80%RH, 240hrs
4	High temperature operation test	Ta = 50 ℃, 240hrs
5	Low temperature operation test	Ta = -5℃, 240hrs
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 100 cycle

12.0 HANDLING & CAUTIONS

(1) Cautions when taking out the module
- Pick the pouch only, when taking out module from a shipping package.

(2) Cautions for handling the module
- As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
- As the LCD panel and back - light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Do not pull the interface connector in or out while the LCD module is operating.
- Put the module display side down on a flat horizontal plane.
- Handle connectors and cables with care.

(3) Cautions for the operation
- When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

(4) Cautions for the atmosphere
- Dew drop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(5) Cautions for the module characteristics
- Do not apply fixed pattern data signal to the LCD module at product aging.
- Applying fixed pattern for a long time may cause image sticking.

(6) Other cautions
- Do not disassemble and/or re-assemble LCD module.
- Do not re-adjust variable resistor or switch etc.
- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

13.0 PRODUCT SERIAL NUMBER

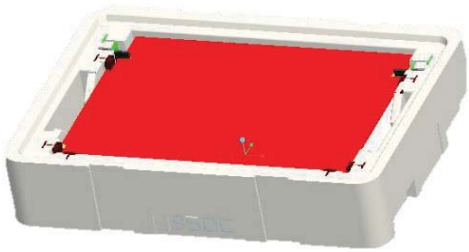
1	2	3	4	5	6	7
X X	X	X	X X	X	X X X X	X X X X X X

1. Control Number
2. Rank / Grade
3. Line Classification
4. Year (2001 : 01, 2002 : 02, …)
5. Month (1,2,3, … , 9, X, Y, Z)
6. Internal Use
7. Serial Number

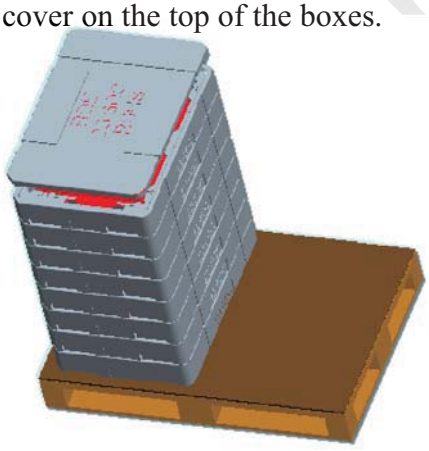
14.0 Packing

14.1 Packing Order

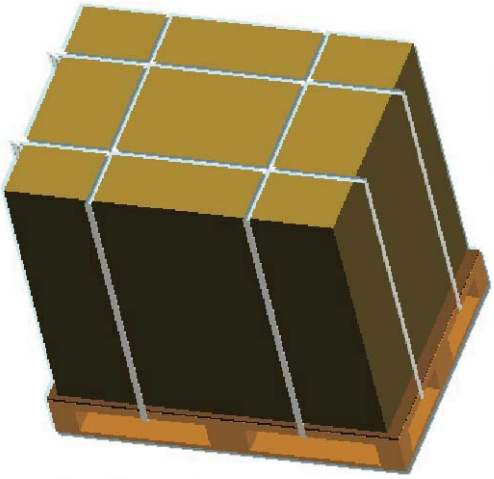
Put EPE pads and open cells into the box, 20pcs open cells per box.



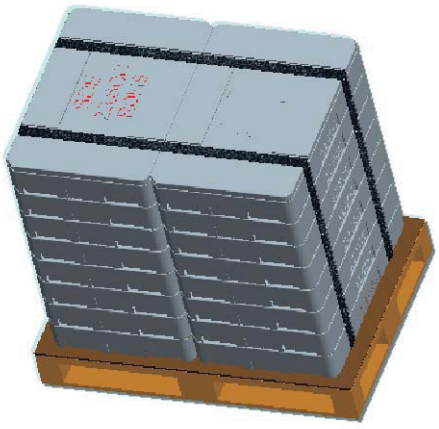
Place the paper pad on the pallet, and put the EPO boxes on the pallet (8ea boxes per row) and a cover on the top of the boxes.



Cover with 1 out box.
Pack with 4 packing belts.



Pack with 2 belts .
(16ea boxes and 2 covers per pallet).



14.2 Packing Note

- Box Dimension : 480mm(W) × 690mm(L) × 110mm(H)
- Package Quantity in one Box : 20pcs

14.3 Box label

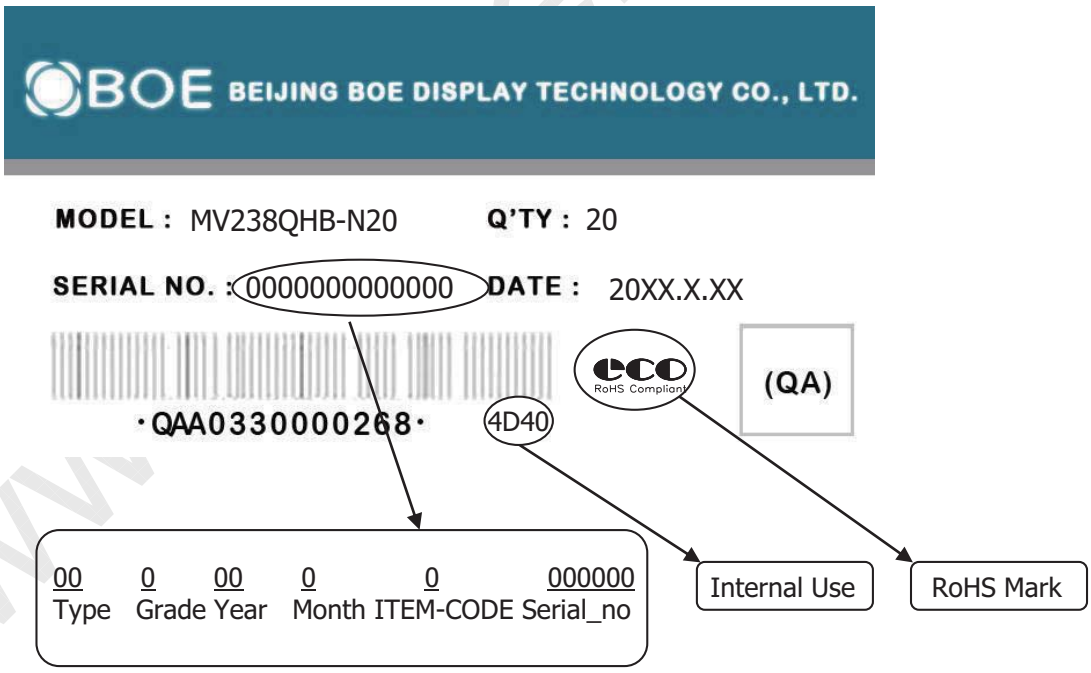
- Label Size : 108 mm (L) × 56 mm (W)
- Contents

  Model : MV238QHB-N20

  Q`ty : OC 20 Q`ty in one box

  Serial No. : Box Serial No. See next page for detail description.

  Date : Packing Date



15.0 APPENDIX

Figure 1. Measurement Set Up

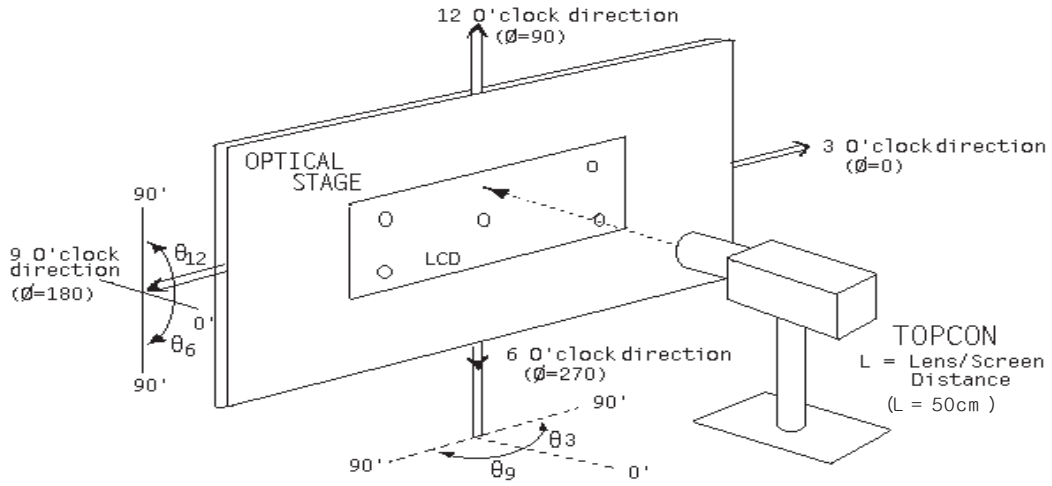


Figure 2. White Luminance and Uniformity Measurement Locations (9 points)

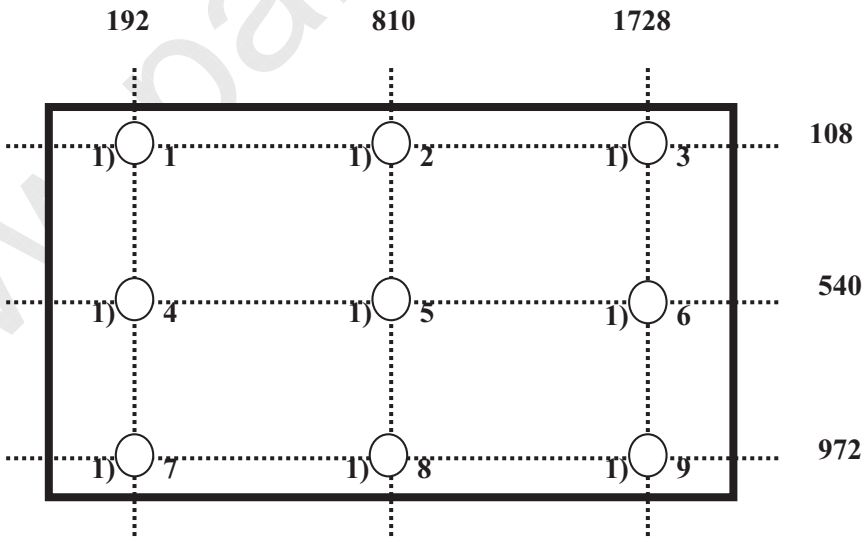


Figure 3. Response Time Testing

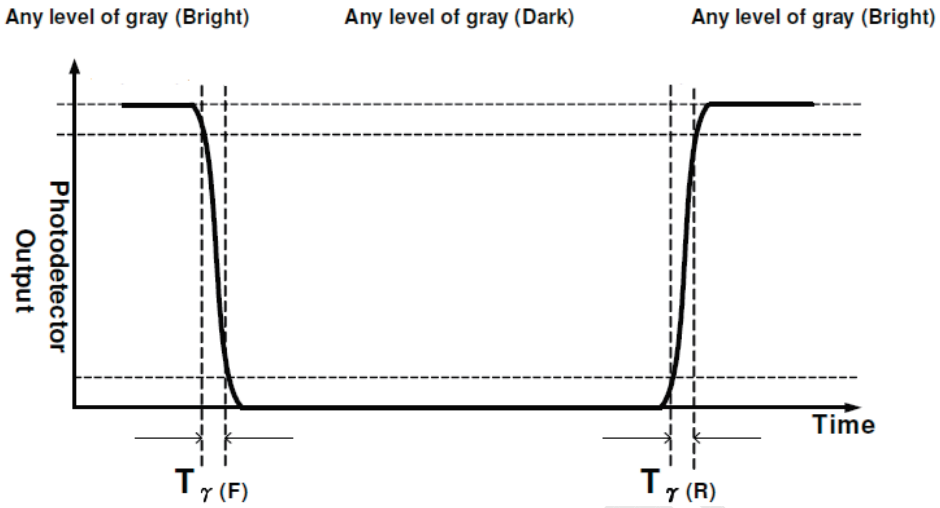
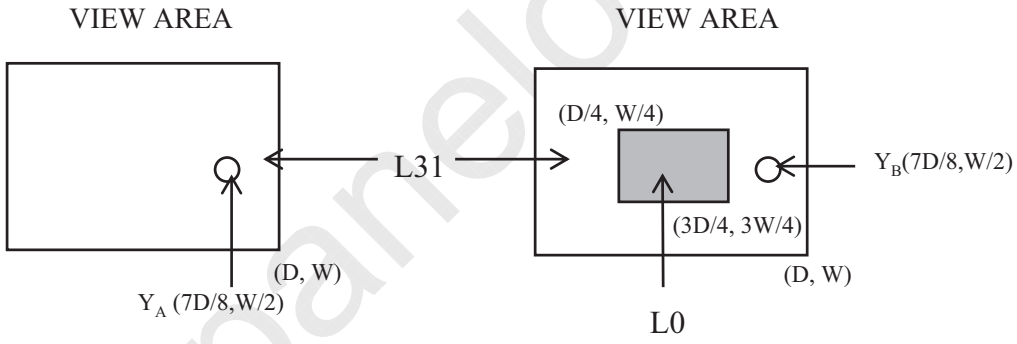


Figure 4. Cross Modulation Test Description



$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where: Y_A = Initial luminance of measured area (cd/m^2)
Y_B = Subsequent luminance of measured area (cd/m^2)
The location measured will be exactly the same in both patterns

Figure 5. TFT-LCD Open Cell Outline Dimensions