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**TITLE : MV238FHM-N60**

**Product Specification**

**Ver. 0**

**BEIJING BOE Display TECHNOLOGY CO. LTD**

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S8-65-8A-125

PRODUCT GROUP  
TFT-LCD

Ver. 0

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1 OF 30



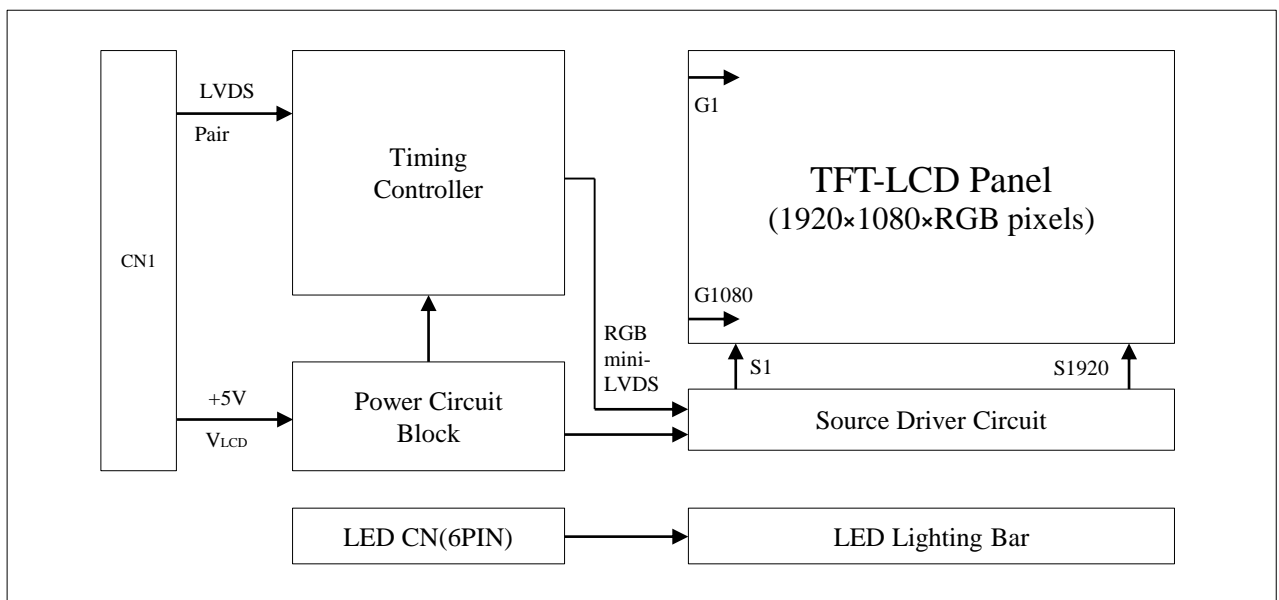
## Contents

<b>No.</b>	<b>Item</b>	<b>Page</b>
1.0	General Description	4
2.0	Absolute Maximum Ratings	6
3.0	Electrical Specifications	7
4.0	Optical Specifications	8
5.0	Interface Connection	10
6.0	Signal Timing Specifications	13
7.0	Signal Timing Waveforms of Interface Signal	15
8.0	Input Signals, Display Colors & Gray Scale of Colors	17
9.0	Power Sequence	18
10.0	Mechanical Characteristics	19
11.0	Reliability Test	20
12.0	Handling& Cautions	21
13.0	Product Serial Number	22
14.0	Packing	23
15.0	Appendix	25

## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

MV238FHM-N60 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 (1920 horizontal by 1080 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
- Incorporated edge type back-light (LED)
- 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 MV238FHM-N60.

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	527.04(H) × 296.46(V)	mm	
Number of pixels	1920(H) × 1080(V)	pixels	
Pixel pitch	0.2745 (H) × 0.2745(V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M	colors	
Display mode	Normally Black		
Dimensional outline	535.0(H) x 313.0(V) x 12 (D) typ.	mm	Detail refer to drawing
Weight	2200(Typ.)	g	
Surface Treatment	Haze 25%, 3H		
Back-light	Horizontal arranged, 1-LED Lighting Bar type		

### 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 >

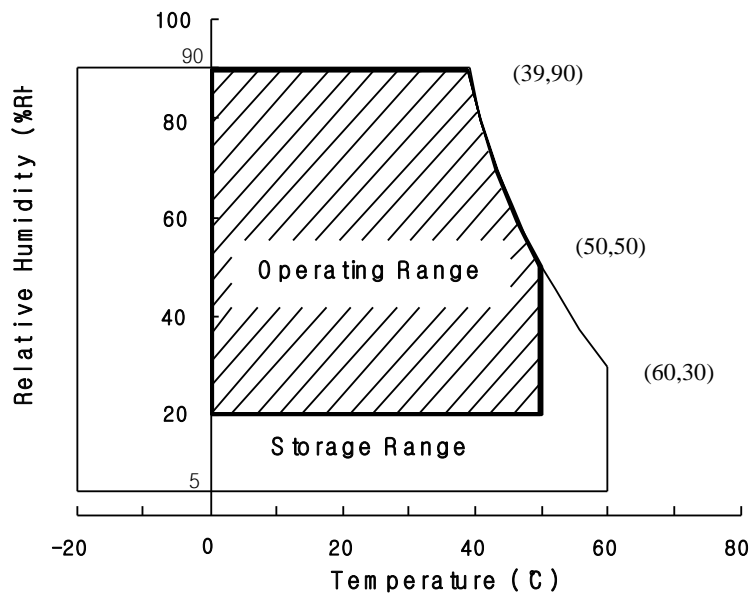
[VSS=GND=0V]

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V <sub>DD</sub>	-0.3	6.0	V	Ta = 25 °C
Logic Supply Voltage	V <sub>IN</sub>	VSS-0.3	V <sub>DD</sub> +0.3	V	
Operating Temperature	T <sub>OP</sub>	0	+50	°C	1)
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	1)
LCM Surface Temperature (Operation)	T <sub>Surface</sub>	0	+65	°C	2)

Note : 1) Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be 39 °C max. and no condensation of water.

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



### 3.0 ELECTRICAL SPECIFICATIONS

#### 3.1 Electrical Specifications

< Table 3. Electrical specifications >

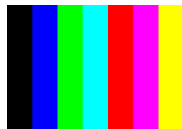
[Ta =25 ± 2 °C]

Parameter.		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V <sub>DD</sub>	4.5	5.0	5.5	V	Note 1
Power Supply Current	I <sub>DD</sub>	-	600	900	mA	
In-Rush Current	I <sub>RUSH</sub>	-	2.0	3.0	A	Note 2
Permissible Input Ripple Voltage	V <sub>RF</sub>	-	-	300	mV	Note 1,3
High Level Differential Input Threshold Voltage	V <sub>IH</sub>	-	-	+100	mV	
Low Level Differential Input Threshold Voltage	V <sub>IL</sub>	-100	-	-	mV	
Differential input voltage	V <sub>ID</sub>	200	-	600	mV	
Differential input common mode voltage	V <sub>cm</sub>	1.0	1.2	1.5		V <sub>IH</sub> =100mV, V <sub>IL</sub> =-100mV
Power Consumption	P <sub>D</sub>	-	3.0	4.5	W	
	P <sub>BL</sub>	-	10.56	11.26	W	Note 4
	P <sub>total</sub>	-	13.56	16.76	W	

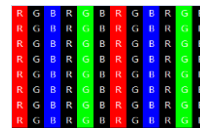
Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for VDD=5.0V, Frame rate=75Hz

Clock frequency = 92.9 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.

### 3.2 Backlight Unit

< Table 4. LED Backlight Unit >

Parameter		Min.	Typ.	Max.	Unit	Remarks
LED Light Bar Input Voltage Per Input Pin	VPIN	-	60	64	V	Duty 100%
LED Light Bar Input Current Per Input Pin	IPIN	-	44	-	mA	Note1,2
LED Power Consumption	P <sub>BL</sub>	-	10.56	11.26	W	Note 3
LED Life-Time	-	30,000	-		Hrs	Note 4

LED bar consists of 80 LED packages, 4 strings(parallel)\*20 packages(serial)

Note1: There are one light bar ,and the specified current is input LED chip 100% duty current

Note2: The sense current of each input pin is 44 mA

Note3:  $P_{BL}=4 \text{ Input pins} \times V_{PIN} \times I_{PIN}$

Note4: The lifetime is determined as the time at which luminance of LED become 50% of the initial brightness or not normal lighting at  $I_{PIN}= 44 \text{ mA}$  on condition of continuous operating at  $25 \pm 2 \text{ }^\circ\text{C}$



## 4.0 OPTICAL SPECIFICATION

### 4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance  $\leq 1$  lux and temperature =  $25 \pm 2^\circ\text{C}$ ) 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  $\theta$  and  $\Phi$  equal to  $0^\circ$ . We refer to  $\theta_{\theta=0}$  ( $=\theta_3$ ) as the 3 o'clock direction (the "right"),  $\theta_{\theta=90}$  ( $=\theta_{12}$ ) as the 12 o'clock direction ("upward"),  $\theta_{\theta=180}$  ( $=\theta_9$ ) as the 9 o'clock direction ("left") and  $\theta_{\theta=270}$  ( $=\theta_6$ ) as the 6 o'clock direction ("bottom"). While scanning  $\theta$  and/or  $\Phi$ , 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  $25^\circ\text{C}$ . Optimum viewing angle direction is 6 'clock.

### 4.2 Optical Specifications

[VDD = 5.0V, Frame rate = 60Hz, Clock = 74.25MHz,  $I_{BL} = 172$  mA,  $T_a = 25 \pm 2^\circ\text{C}$ ]

< Table 5. Module Optical >

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	$\theta_3$	CR > 10	85	89	-	Deg.	Note 1
		$\theta_9$		85	89	-	Deg.	
	Vertical	$\theta_{12}$		85	89	-	Deg.	
		$\theta_6$		85	89	-	Deg.	
Luminance Contrast ratio		CR	$\theta = 0^\circ$ (Center) Normal Viewing Angle	700	1000			Note 2
Luminance of White		$Y_w$		200	250		cd/m <sup>2</sup>	Note 3
White luminance uniformity		$\Delta Y$		75	-		%	Note 4
Reproduction of color	White	$W_x$		0.283	0.313	0.343	-	Note 5
		$W_y$	0.299	0.329	0.359	-		
	Red	$R_x$	0.609	0.639	0.669	-		
		$R_y$	0.326	0.356	0.386	-		
	Green	$G_x$	0.273	0.303	0.333	-		
		$G_y$	0.601	0.631	0.661	-		
	Blue	$B_x$	0.117	0.147	0.177	-		
		$B_y$	0.021	0.051	0.081	-		
Response Time	GTG	$T_g$		14	25	ms	Note 6	

**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  $\theta = 0^\circ$  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. 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.
4. The White luminance uniformity on LCD surface is then expressed as :
 
$$\Delta Y = (\text{Minimum Luminance of 9points} / \text{Maximum Luminance of 9points}) * 100$$
 (See FIGURE 2 shown in Appendix).
5. 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.
6. 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  $f_v = 60\text{Hz}$  to optimize.  
Each time in below table is defined as Figure 3 and shall be measured by switching the input signal for "any level of gray(bright)" and "any level of gray(dark)".

## 5.0 INTERFACE CONNECTION.

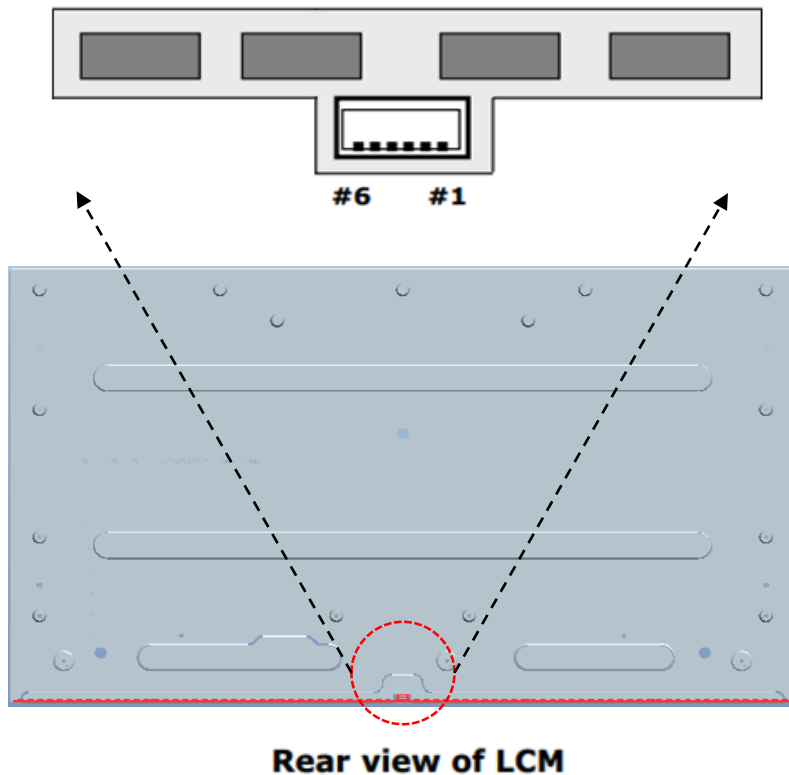
### 5.1 Electrical Interface Connection

#### 5.1.1 LED Light Bar

-LED connector: BM06B-SHJS-TB manufactured by JST or Equivalent

< Table 6. LED Light Bar >

Pin No	Symbol	Description
1	IRLED1	LED current sense for string1
2	IRLED2	LED current sense for string2
3	VLED	LED power supply
4	VLED	LED power supply
5	IRLED3	LED current sense for string3
6	IRLED4	LED current sense for string4



## 5.0 INTERFACE CONNECTION.

### 5.1 Electrical Interface Connection

- CN101 Module Side Connector : UJU IS100-L300-C23or Equivalent  
User Side Connector : JAE FI-X30H or Equivalent

Pin No	Symbol	Function	Remark
Pin No	Symbol	Function	Remark
1	RX00-	Negative Transmission data of Pixel 0 (ODD)	
2	RX00+	Positive Transmission data of Pixel 0 (ODD)	
3	RX01-	Negative Transmission data of Pixel 1 (ODD)	
4	RX01+	Positive Transmission data of Pixel 1 (ODD)	
5	RX02-	Negative Transmission data of Pixel 2 (ODD)	
6	RX02+	Positive Transmission data of Pixel 2 (ODD)	
7	BIST	3.3V BIST ON : Ground/NC BIST OFF	
8	RXOC-	Negative Transmission Clock (ODD)	
9	RXOC+	Positive Transmission Clock (ODD)	
10	RX03-	Negative Transmission data of Pixel 3 (ODD)	
11	RX03+	Positive Transmission data of Pixel 3 (ODD)	
12	RXE0-	Negative Transmission data of Pixel 0 (EVEN)	
13	RXE0+	Positive Transmission data of Pixel 0 (EVEN)	
14	GND	Power Ground	
15	RXE1-	Negative Transmission data of Pixel 1 (EVEN)	
16	RXE1+	Positive Transmission data of Pixel 1 (EVEN)	
17	GNG	Power Ground	
18	RXE2-	Negative Transmission data of Pixel 2 (EVEN)	
19	RXE2+	Positive Transmission data of Pixel 2 (EVEN)	
20	RXEC-	Negative Transmission Clock (EVEN)	
21	RXEC+	Positive Transmission Clock (EVEN)	
22	RXE3-	Negative Transmission data of Pixel 3 (EVEN)	
23	RXE3+	Positive Transmission data of Pixel 3 (EVEN)	
24	GND	Power Ground	Note 1
25	NC	No. Connection	
26	NC		
27	NC		
28	VDD	Power Supply: +5V	
29	VDD		
30	VDD		

Note 1: This pin should be connected with GND.

### 5.2 LVDS Interface (Tx; THC63LVDF83A or Equivalent)

#### 5.2.1 LVDS Interface

	Input Signal	Transmitter		Interface		MV238FHM-N60 (CN11)	Remark				
		Pin No.	Pin No.	System (Tx)	TFT-LCD (Rx)	Pin No.					
LVDS	OR0	51	48 47	OUT0- OUT0+	RX00- RX00+	1 2					
	OR1	52									
	OR2	54									
	OR3	55									
	OR4	56									
	OR5	3									
	OG0	4	46 45	OUT1- OUT1+	RX01- RX01+	3 4					
	OG1	6									
	OG2	7									
	OG3	11									
	OG4	12									
	OG5	14									
	OB0	15	42 41	OUT2- OUT2+	RX02- RX02+	5 6					
	OB1	19									
	OB2	20									
	OB3	22									
	OB4	23									
	OB5	24									
	Hsync	27	40 39	CLK OUT- CLK OUT+	RXO CLK- RXO CLK+	8 9					
	Vsync	28									
DE	30										
MCLK	31										
OR6	50	38 37						OUT3- OUT3+	RXO3- RXO3+	10 11	
OR7	2										
OG6	8										
OG7	10										
OB6	16										
OB7	18										
RSVD	25										

Note: The order of even data is same with odd data.

## 6.0 SIGNAL TIMING SPECIFICATION

6.1 The MV238FHM-N60 is operated by the DE only.

Item	Symbols		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	10.47	13.47	16.84	ns	
	Frequency	-	57.74	74.25	95.5	MHz	
Hsync	Period	tHP	1050	1100	1120	tCLK	
	Horizontal Valid	tHV	960	960	960	tCLK	
	Horizontal Blank	tHB	90	140	160		
	Frequency	fH	54.69	67.5	84.5	KHz	
Vsync	Period	tVP	1110	1125	1251	tHP	2)
	Vertical Valid	tVV	1080	1080	1080	tHP	
	Vertical Blank	tVB	30	45	171	tHP	
	Frequency	fV	48	60	75	Hz	3)
LVDS Receiver clock	Input spread spectrum ratio	SSr	-3	-	+3	%	

Note: 1) The DCLK range at last line of V-blanking should be set in 0~987

2) V-total maximum can reach 1300 when mode is applied @1080i 50Hz

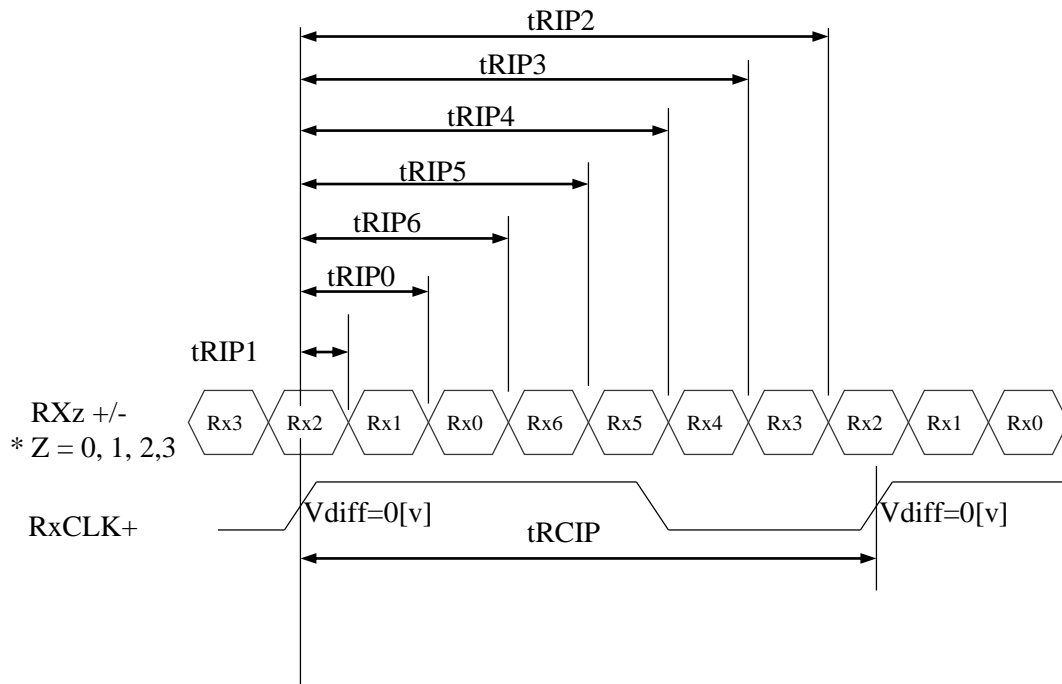
3) Vsync Frequency maximum can reach 77Hz when the resolution is applied@ 1024\*768 ,1152\*870,1152\*900 1280\*1024

## 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>

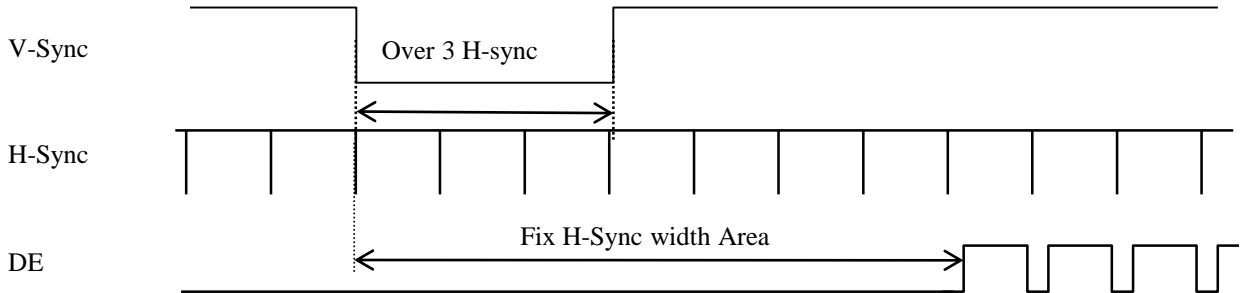
Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	10.47	13.47	16.84	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 × tRCIP/7-0.4	2 × tRCIP/7	2 × tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 × tRCIP/7-0.4	3 × tRCIP/7	3 × tRCIP/7+0.4	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-)

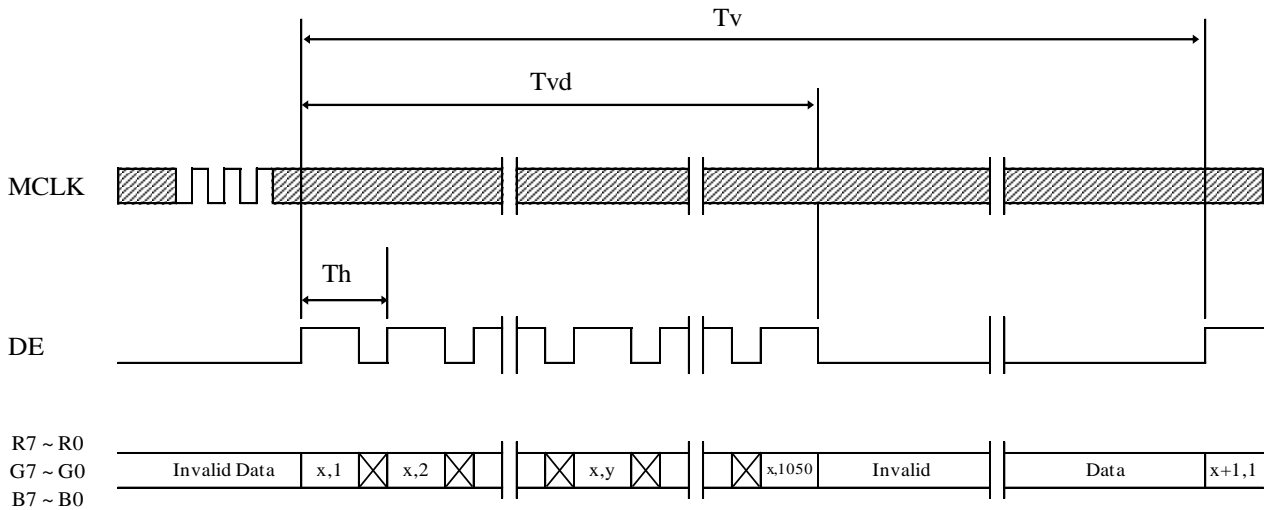
## 7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL

### 7.1 Sync Timing Waveforms



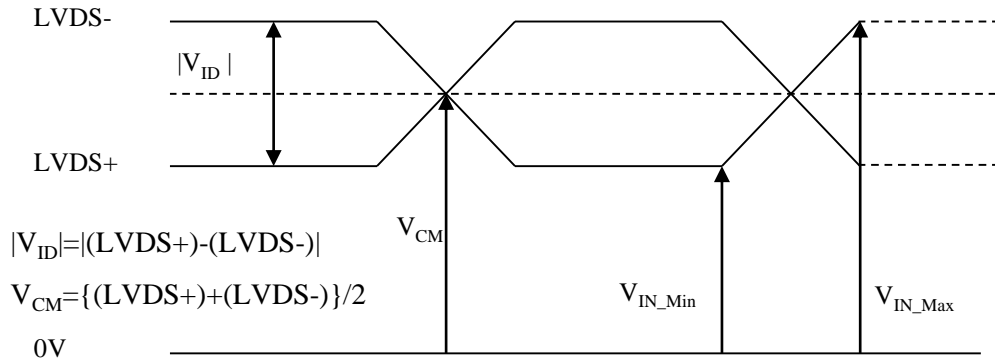
- 1) Need over 3 H-sync during V-Sync Low
- 2) Fix H-Sync width from V-Sync falling edge to first rising edge

### 7.2 Vertical Timing Waveforms

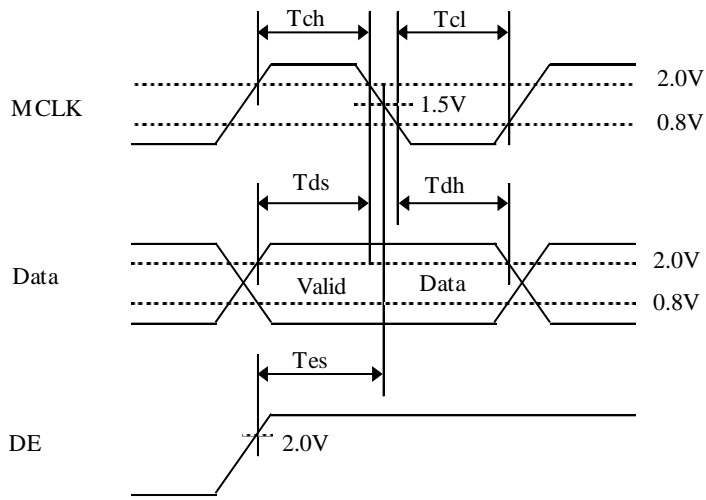
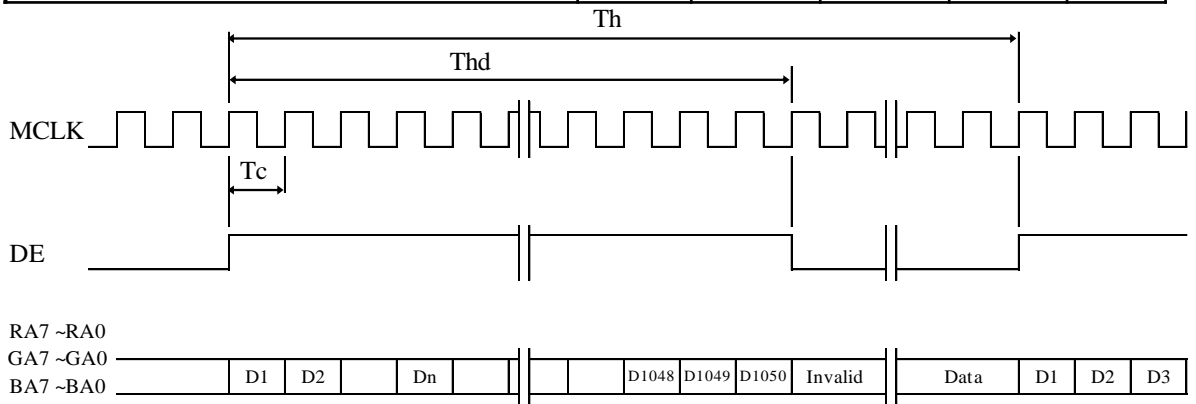




### 7.3 Horizontal Timing Waveforms



Differential input voltage	$ V_{ID} $	200	-	600	mV
Differential input common mode voltage	$V_{CM}$	1.0	1.2	1.5	V

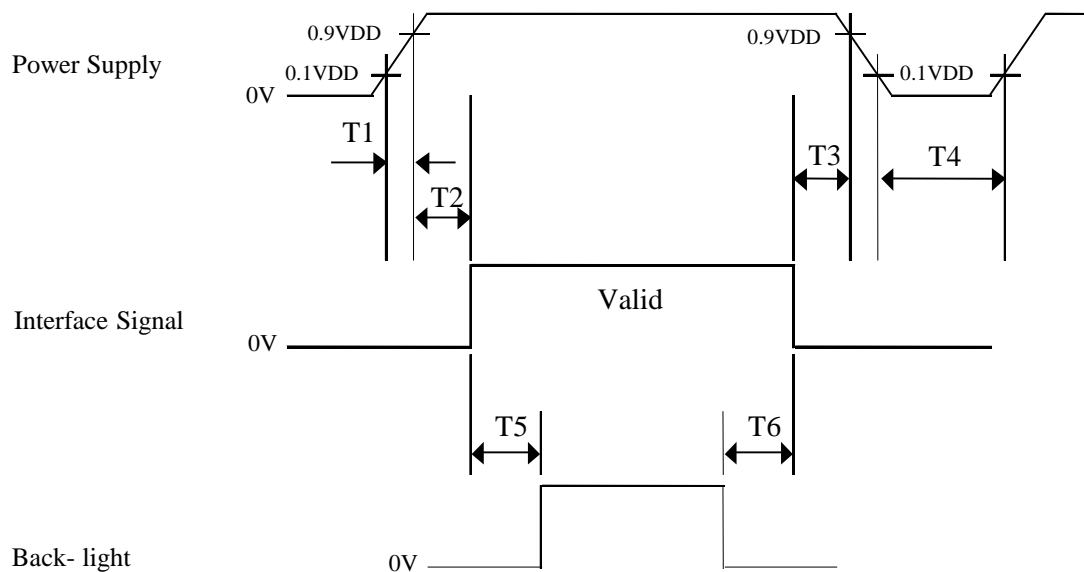


## 8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

Color & Gray Scale																									
		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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Darker	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	1	0	0	0	0	0	0	0	0	
	Darker	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	1	
	Darker	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	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
	Darker	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.



- $0.5 \text{ ms} \leq T1 \leq 10 \text{ ms}$
- $0 \leq T2 \leq 50 \text{ ms}$
- $0 < T3 \leq 50 \text{ ms}$
- $1 \text{ sec} \leq T4$
- $200 \text{ ms} \leq T5$
- $200 \text{ ms} \leq T6$

#### Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.
4. T7 decreases smoothly, there is none re-bouncing voltage.
5. If T3=0ms, there is a risk of flicker when power On/Off.
6. If T6=0ms, there is a risk of abnormal display when power off. but it will be no reliability concern.

## 10.0 MECHANICAL CHARACTERISTICS

### 10.1 Dimensional Requirements

FIGURE 6 (located in Appendix) shows mechanical outlines for the model MV238FHM-N60. Other parameters are shown in Table 5.

<Table 5. Dimensional Parameters>

Parameter	Specification	Unit
Dimensional outline	535.0(H) X 313.0(V) X 12 mm (Typ.)	mm
Weight	2200 (typ)	gram
Active area	527.04 (H) × 296.46 (V)	mm
Pixel pitch	0.2745(H)mm x 0.2745(V)mm	mm
Number of pixels	1920 (H) × 1080 (V) (1 pixel = R + G + B dots)	pixels
Back-light	Lower edge side, 1-LED Lighting Bar type	

### 10.2 Mounting

See FIGURE 5. (shown in Appendix)

### 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 RELIABILITY 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 °C, 240 hrs	
2	Low temperature storage test	Ta = -20 °C, 240 hrs	
3	High temperature & high humidity operation test	Ta = 50 °C, 80%RH, 240hrs	
4	High temperature operation test	Ta = 50 °C, 240hrs	
5	Low temperature operation test	Ta = 0°C, 240hrs	
6	Thermal shock	Ta = -20 °C ↔ 60 °C (0.5 hr), 100 cycle	
7	Vibration test (non-operating)	Frequency	Random, 10 ~ 300 Hz, 30 min/Axis
		Gravity\ AMP	1.5 Grms
		Period	X, Y, Z 30 min
8	Shock test (non-operating)	Gravity	50G
		Pulse width	11msec, sine wave
		Direction	± X, ± Y, ± Z Once for each
9	Electro-static discharge test	Air : 150 pF, 330Ω, 15 KV Contact : 150 pF, 330Ω, 8 KV	

## 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

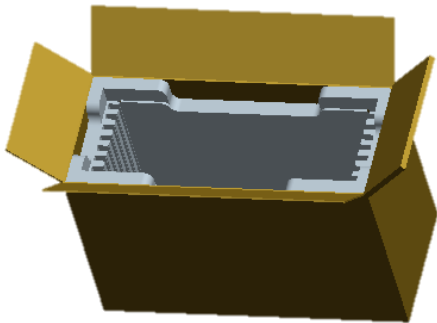
DP/N XXXXXX	MV238FHM-N60	B4	
XXXX	XXXXXXXX-XXXX-XXXXXXXX	REV A00	
			  MADE IN CHINA
XX-XXXXXXXX-XXXXX-XXX-XXXX			

Digit	1	2	3	4	5	6						7						
Code	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Des.	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. Model Extension Code(Last 4 digits of FG-code) 7. Serial Number																	

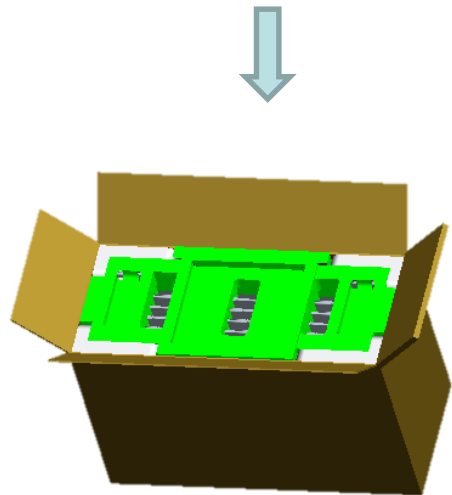
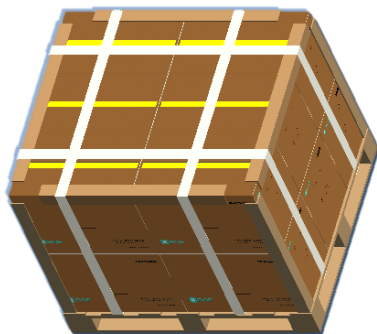
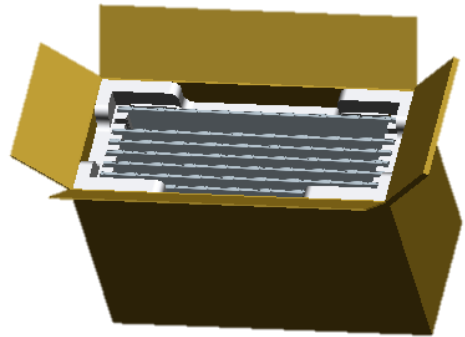
## 14.0 Packing

### 14.1 Packing Order

Put 1 EPO bottom into the inner box.



Put each module into a PE bag.  
Insert 9 Pcs MDL into each box



Place paper corners and wrap film around the boxes.  
Pack with 4 packing belts.

Put 1 EPO cover in and seal the box.



### 14.2 Packing Note

- Box Dimension : 631mm(W) × 318mm(L) × 419mm(H)
- Package Quantity in one Box : 9pcs

### 14.3 Box label

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

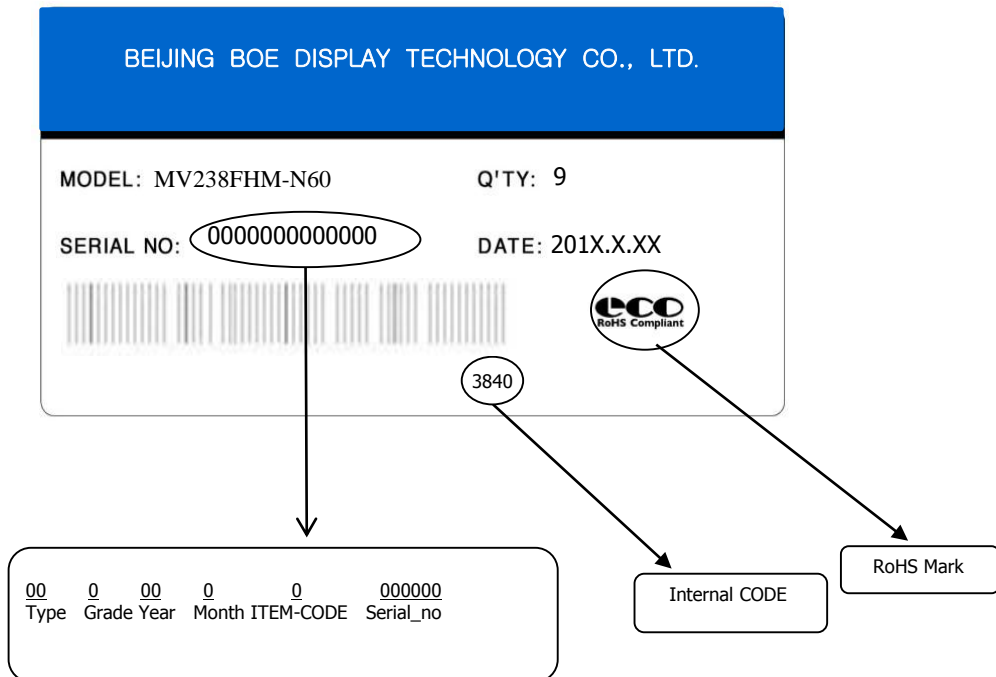
Model : MV238FHM-N60

Q`ty : Module 9 Q`ty in one box

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

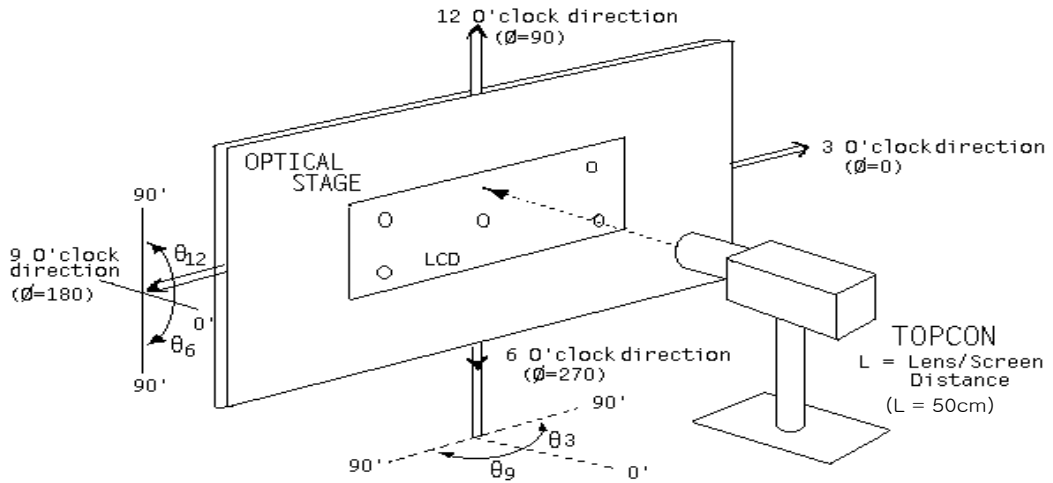
Date : Packing Date

FG Code : FG Code of Product

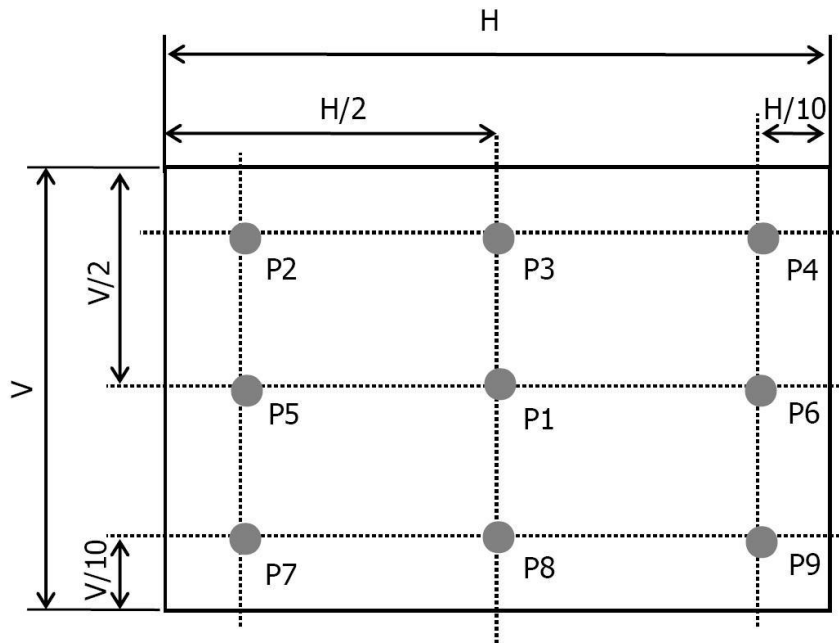


## 15.0 APPENDIX

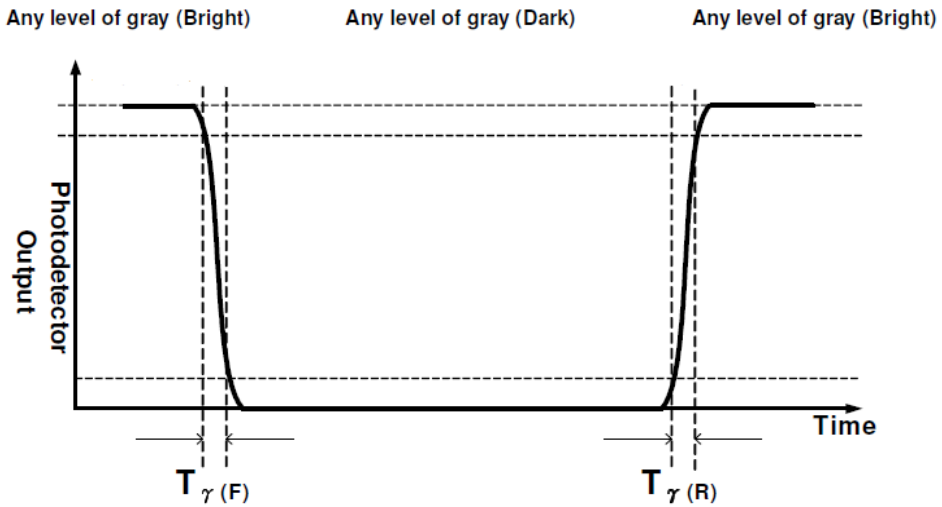
**Figure 1. Measurement Set Up**



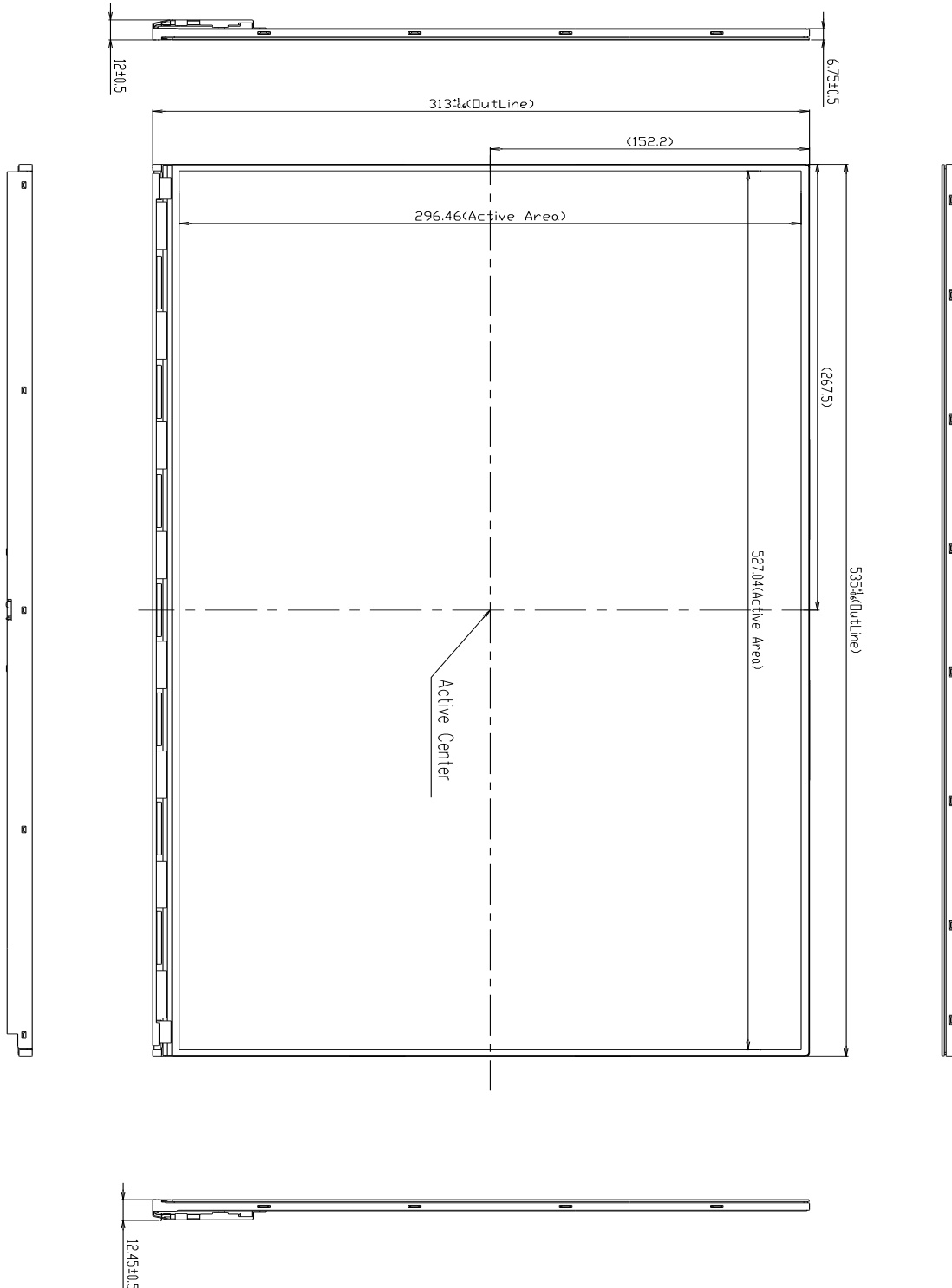
**Figure 2. White Luminance and Uniformity Measurement Locations (9 points)**



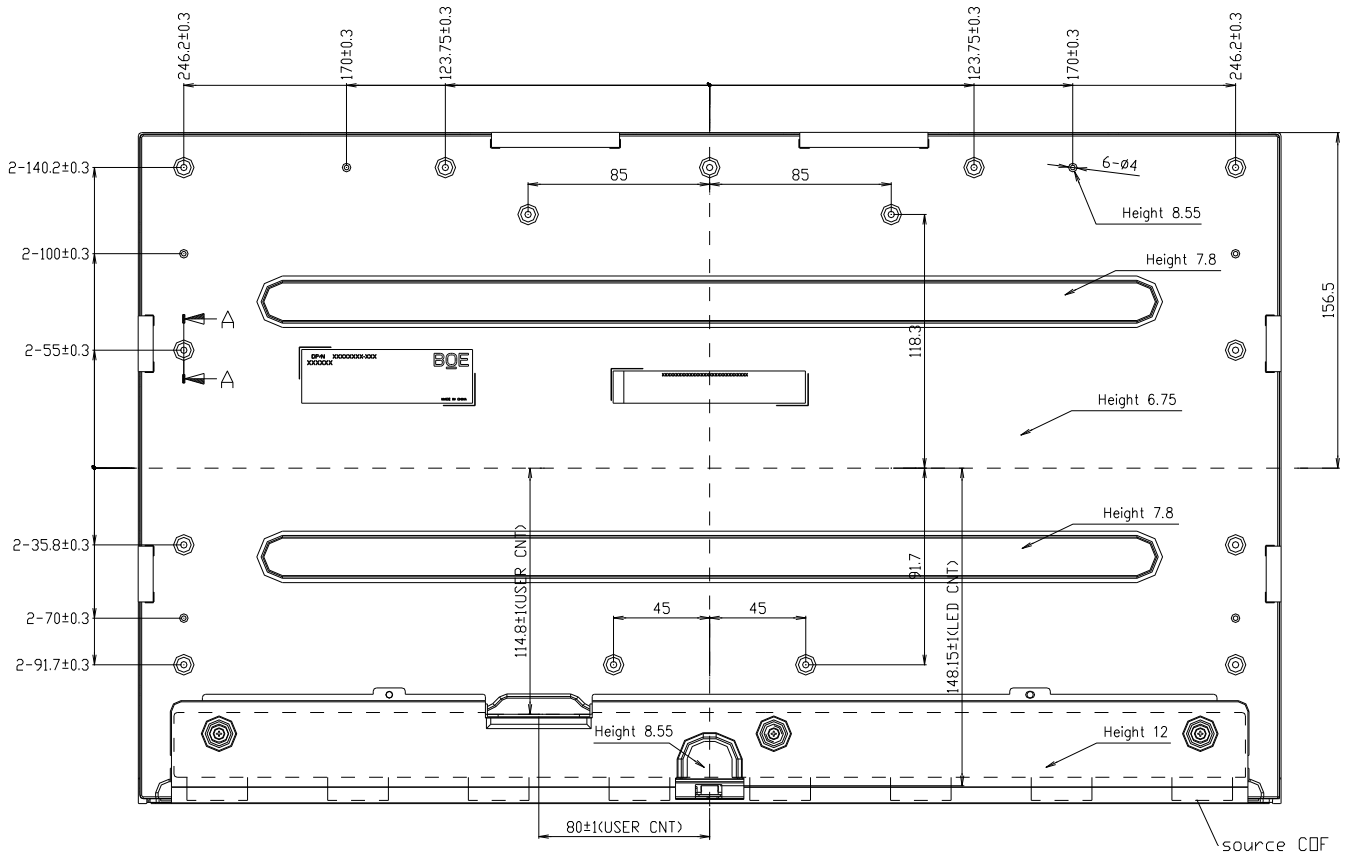
**Figure 3. Response Time Testing**



**Figure 5. TFT-LCD Module Outline Dimensions (Front view)**

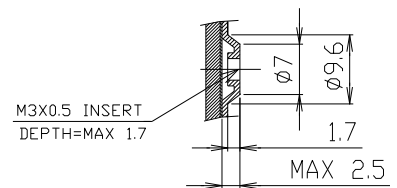


**Figure 6. TFT-LCD Module Outline Dimensions (Rear view)**

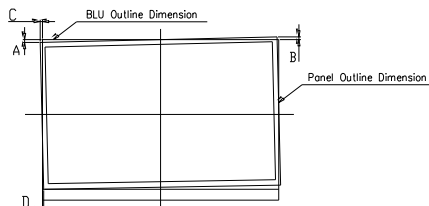


**NOTE:**

1. I/F CONNECTOR SPECIFICATION  
IS100-L300-C23(UJU) or EQUIVALENT
2. LED CONNECTOR SPECIFICATION  
BM06B-SHJS-TB(JST) or 10035WS-H06D(YEONHD) or EQUIVALENT
3. USER MOUNTING TORQUE SPEC : 3 ~ 4 kgf-cm  
Tilt and partial disposition tolerance of display area as following  
(1)Y-direction  $0.45 \leq A \leq 0.45$ ,  $-0.45 \leq B \leq 0.45$   
(2)X-direction  $0.45 \leq C \leq 0.45$ ,  $-0.45 \leq D \leq 0.45$



SECTION A-A (S2/1)  
(15 PCS)



4.The CDF area is weak & sensitive, so please don't press the CDF Area