TITLE : MV238QHM-NF0-4940/4D30

Product Specification

BEIJING BOE Display TECHNOLOGY

REVISION HISTORY

( ) Preliminary specification
(●) Final specification

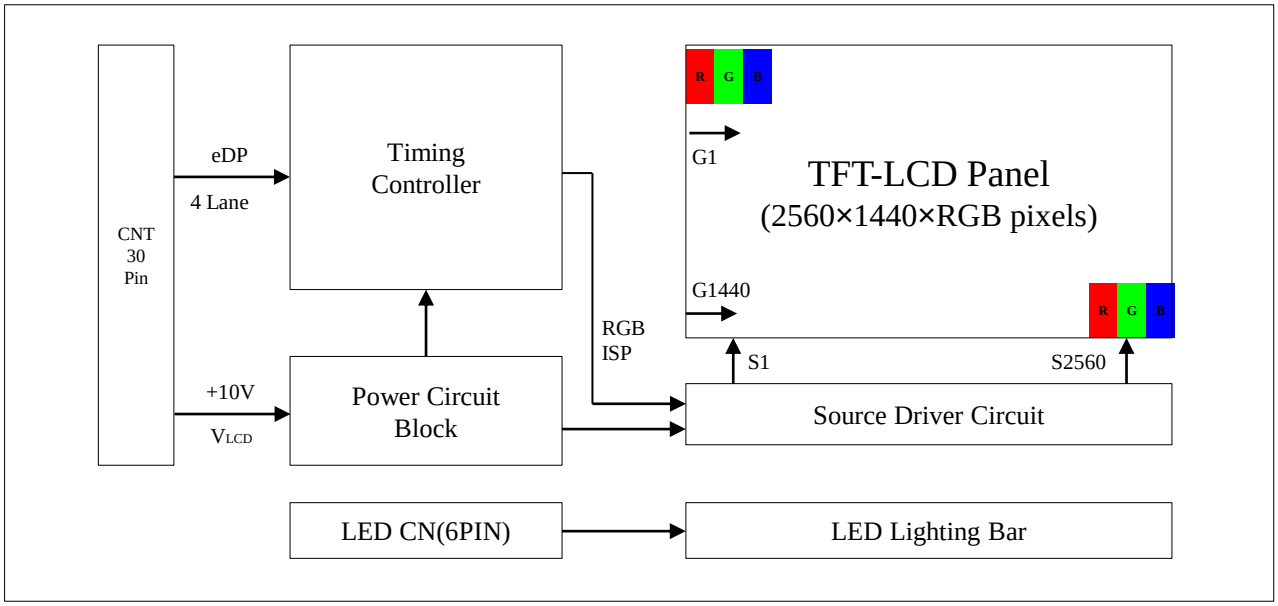
Revision No.	Page	Description of changes	Date	Prepared
P0		Initial Release	2021.07.05	Tian Ming
P1		Label Position	2021.07.29	Tian Ming
P2	P11 P31 P32	Update eDP CNT type Update outline torelance	2021.10.08	Tian Ming
P3	P9	Update Reproduction of color	2021.11.01	Tian Ming
P4	P7	Power Supply Current 1500→1900mA Max Pattern：Skip Sub Pixel	2021.11.22	Tian Ming
P5	P32	PCB Cover Update	2021.11.23	Tian Ming
P6	P7 P8	Update Power Consumption& LED Light Bar Input Current Per Input Pin& LED Power Consumption	2022.01.10	Tian Ming
P7	P6	Power Supply Voltage	2022.02.07	Tian Ming
P8	P7	Power Supply Current LED Channel Voltage LED Channel Current Power Consumption	2022.02.14	Tian Ming
Rev.O		Final specification	2022.02.14	Tian Ming

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

MV238QHM-NF0 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

- Lanes eDP Interface with 5.4Gbps Link Rates
- High-speed response
- 8bit color depth, display 16. 7M colors
- High luminance and contrast ratio, low reflection and wide viewing angle
- DE (Data Enable) only
- RoHS/Halogen Free
- CEC,CEL2 compliant
- Gamma Correction
- Reverse type
- Compatible with Color Gamut 99%(Typ)@sRGB(CIE 1976)
- TUV Rheinland-low blue light authentication(Method 2) pass
- Low blue light panel

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 MV238QHM-NF0.

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	526.08(H) × 295.92(V)	mm	
Number of pixels	2560(H) ×1440(V)	pixels	
Pixel pitch	0.2055(H) ×0.2055(V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M	colors	
Display mode	Normally Black		
Dimensional outline	535.0 (H)×313.0(V)×12.7 (D)Typ.	mm	Detail refer to drawing
Weight	2300	g	
Bezel width (L/R/U/D)	None	mm	
Surface Treatment	Haze 25%, 3H		
Back-light	Horizontal arranged, 1-LED Lighting Bar type		

2.0 ABSOLUTE MAXIMUM RATINGS

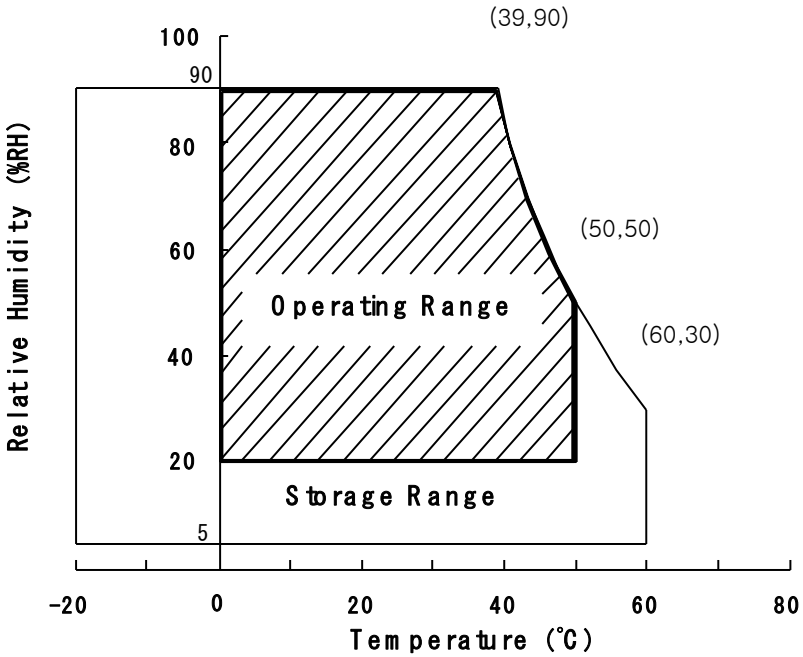
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

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

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	0.3	10.5	V	Ta = 25 ℃
Logic Supply Voltage	VIN	VSS-0.3	VDD+0.3	V	
Operating Temperature	T_{OP}	0	+50	℃	1)
Storage Temperature	T_{ST}	-20	+60	℃	1)
LCM Surface Temperature (Operation)	Tsurface	0	+65	℃	2)

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.

2) Panel Surface Temperature should be Min. 0^{O}C and Max. +65^{O}C under the VDD = 10.0V, Frame rate = 60Hz,25^{O}C ambient Temp. no humidity control and LED string current is typical value.



3.0 ELECTRICAL SPECIFICATIONS

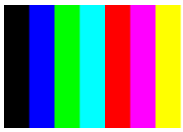
3.1Electrical Specifications

< Table 3. Electrical specifications >

[Ta =25 ± 2 ℃]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	9.5	10.0	10.5	V	Note1
Power Supply Current	I_{DD}	-	900	2000	mA	
In-Rush Current	I_{RUSH}	-	2.0	3.0	A	Note 2
Permissible Input Ripple Voltage	V_{RF}	-	-	400	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
LED Voltage	V_L	-	3.0	3.1	V	
LED Channel Voltage	V_L	-	48	49.6	V	
LED Channel Current	I_L	-	109	-	mA	
LED Lifetime		30,000	-	-	Hrs	I_L=109 mA
Power Consumption	P_D	-	9	21	W	165Hz
	P_{BL}	-	20.93	21.63	W	I_L=109 mA, **Note 3**
	P_{total}	-	29.93	42.63	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=10.0V, Frame rate=165Hz.
Test Pattern of power supply current
a) Typ : Color Test
b) Max : Skip Sub 255



a. Color Test

b. Skip Sub Pixel L255

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	-	48	49.6	V	Duty 100%
LED Light Bar Input Current Per Input Pin	IPIN	-	109	-	mA	Note1,2,
LED Power Consumption	P_{BL}		20.93	21.63	W	Note 3
LED Life-Time	-	30,000	-		Hrs	Note 4

LED bar consists of 64LED packages,4strings(parallel)*16packages(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 109mA

Note3: P_{BL}=4Input pins*VPIN ×IPIN

Note4: The lifetime is determined as the time at which luminance of LED become 50% of the initial brightness or not normal lighting at IPIN=109mA on condition of continuous operating at 25 ±2 ℃

<Table5. LED Backlight Unit (≥@400nit typ.)>

Parameter		Min.	Typ.	Max.	Unit	Remarks
LED Light Bar Input Voltage Per Input Pin	VPIN	48	49.6	51.2	V	Duty 100%
LED Light Bar Input Current Per Input Pin	IPIN	-	129	-	mA	Note 1
MDL peak brightness	-	-	400	-	nit	

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°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 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 = 10.0V, Frame rate = 144Hz, Clock = 588.6MHz, **I_{BL} = 436mA,** Ta =25 ± 2 °C]

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
Luminance of White		Y_w		280	350		cd/m^2	Note 3
White luminance uniformity		ΔY		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		0.631	0.661	0.691	-	
		R_y		0.275	0.305	0.335	-	
	Green	G_x		0.304	0.334	0.364	-	
		G_y		0.583	0.613	0.643	-	
	Blue	B_x		0.110	0.140	0.170	-	
		B_y		0.021	0.051	0.081	-	
Response Time	GTG	T_g		-	5.x	11	ms	Note 6
Cross Talk		CT		-	-	2.0	%	Note 7

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. 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 :
   ΔY = (Minimum Luminance of 9points / 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 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)".

Measured Response Time		Target				
		0	63	127	191	255
Start	0					
	63					
	127					
	191					
	255					

7. 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 : UJU-IS050-L30B-C10(30P)

Pin No	Symbol	Function	Pin No	Symbol	Function
1	VIN	Power Supply +10.0v	16	LANE0P	True Signal for Main Link 0
2	VIN	Power Supply +10.0v	17	LANE0N	Component Signal for Main Lin k 0
3	VIN	Power Supply +10.0v	18	GND	Ground
4	VIN	Power Supply +10.0v	19	LANE1P	True Signal for Main Link 1
5	VIN	Power Supply +10.0v	20	LANE1N	Component Signal for Main Lin k 1
6	GND	Ground	21	GND	Ground
7	GND	Ground	22	LANE2P	True Signal for Main Link 2
8	SCLG	*Reserved for LCD manufacturer‘s use (SCL)	23	LANE2N	Component Signal for Main Lin k 2
9	SDAG	*Reserved for LCD manufacturer‘s use (SDA)	24	GND	Ground
10	GND	Ground	25	LANE3P	True Signal for Main Link 3
11	HPD	Hot Plug Detect Signal	26	LANE3N	Component Signal for Main Lin k 3
12	GND	Ground	27	GND	Ground
13	AUX_CH N	Component Signal for Auxil iary Channel	28	GND	Ground
14	AUX_CH P	True Signal for Auxiliary C hannel	29	NC	No. Connection
15	GND	Ground	30	BIST_IN	BIST Function

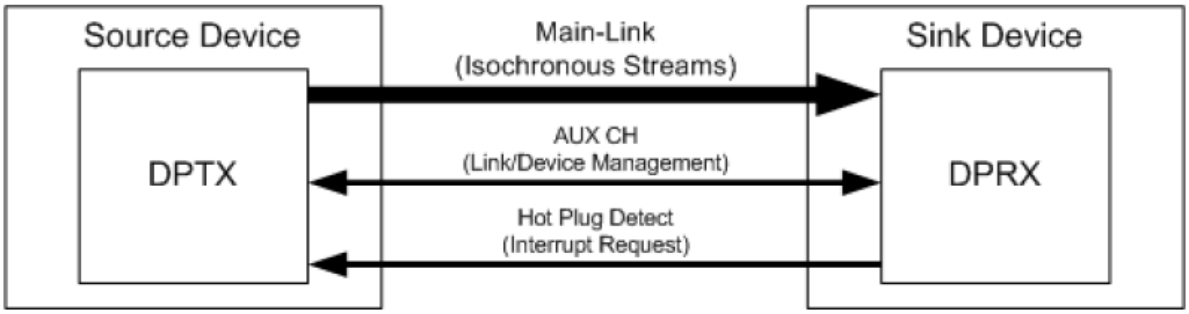
Note 1: H: White-Black-Red-Green-Blue Pattern Aging, L: Black Pattern, when no LVDS signal.

Note 2: This pin should be connected with GND.

5.2 EDPInterface

5.2.1 EDP Interface

- eDP Data Transport Channels



eDP Data Transport Channels

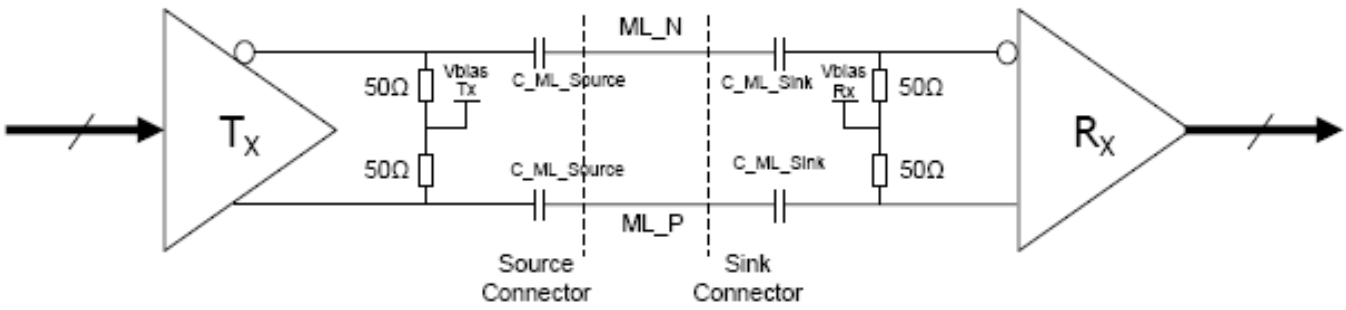
- The TCON supports 4 lane 8 bit input eDP architecture. The data mapping is shown as below：

Lane 0	Lane 1	Lane 2	Lane 3
R0-7:0	R1-7:0	R2-7:0	R3-7:0
G0-7:0	G1-7:0	G2-7:0	G3-7:0
B0-7:0	B1-7:0	B2-7:0	B3-7:0
R4-7:0	R5-7:0	R6-7:0	R7-7:0
G4-7:0	G5-7:0	G6-7:0	G7-7:0
B4-7:0	B5-7:0	B6-7:0	B7-7:0
R8-7:0	R9-7:0	R10-7:0	R11-7:0
G8-7:0	G9-7:0	G10-7:0	G11-7:0
B8-7:0	B9-7:0	B10-7:0	B11-7:0

8bit RGB to a 4-Lane Main-Link Mapping

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

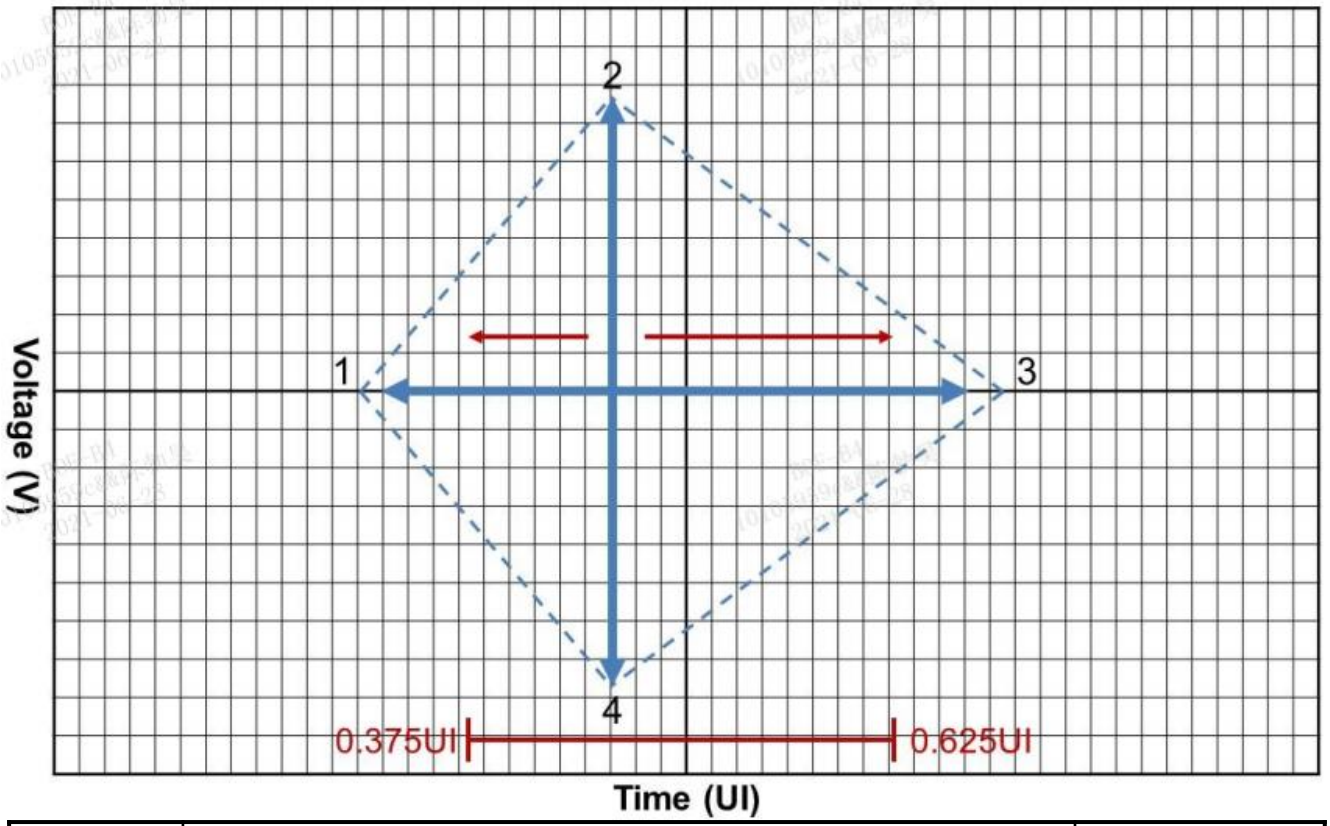
5.3.1 eDP Main Link Signal



Parameter	Symbol	Min	Typ	Max	Unit	Notes
Unit Interval for high bit rate2(5.4Gbps/lane)	UI-HBR2	-	185	-	ps	
Link Clock Down Spreading	Amplitude	0	-	0.5	%	
	Frequency	30	-	33	kHz	TBD
Differential peak-to-peak input voltage at package pins	$V_{RX-DIFFp-p}$	-	-	1.38	V	
EYE width at Sink side connector	$T_{RX-EYE-CONN}$	0.25	-	-	UI	TBD
Lane-to-Lane skew	$L_{Rx-SKEWINTER\_PAIR}$	-	-	1250	-	TBD
Lane intra-pair skew	$L_{Rx-SKEWINTER\_PAIR}$	-	-	50	ps	
AC Coupling Capacitor	C_{SOURCE_ML}	75	-	265	nF	Source side

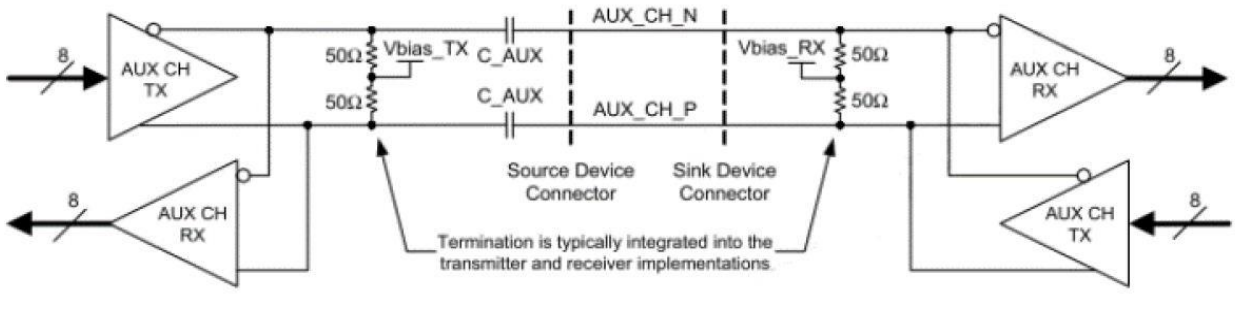
Note :

1. Main link eye diagram mask and equalizer model are respectively defined in eDP1.4b standard.



Point	Time(UI)	Voltage(V)
1	Any UI location(x), where the EYE width is open from x to x + 0.5UI	0.0000
2	Any passing location between 0.375UI and 0.625UI	0.0375
3	Point 1 + 0.5UI	0.0000
4	Same as Point 2	-0.0375

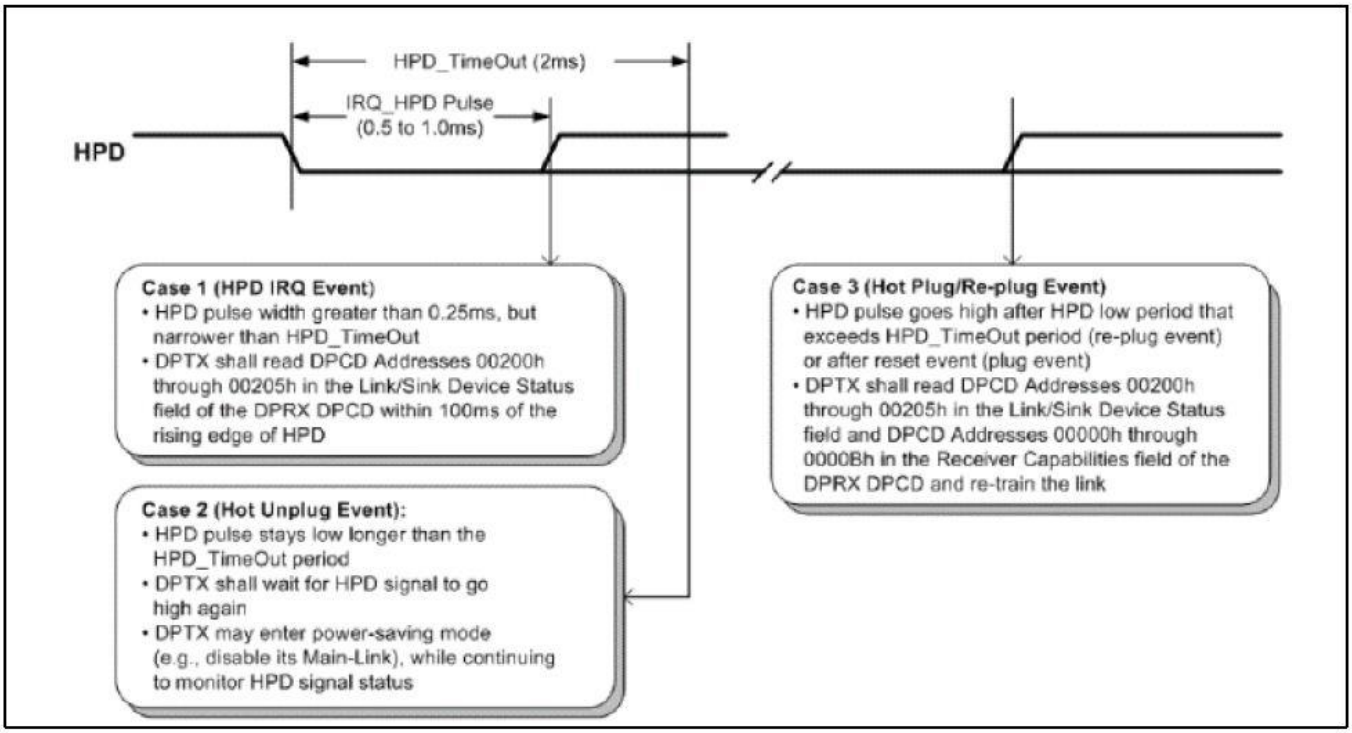
5.3.2 eDP AUX Channel Signal



Recommended eDP AUX Channel Differential Pair

Parameter	Symbol	Min	Typ	Max	Unit	Notes
AUX Unit Interval	UI	0.4	-	0.6	μs	
AUX Jitter at Tx IC Package Pins	T_{jitter}	-	-	0.04	UI	
AUX Jitter at Rx IC Package Pins		-	-	0.05	UI	
AUX Peak-to-peak voltage at Connecto r Pins of Receiving	$V_{AUX-DIFFP-P}$	0.27	-	1.36	V	
AUX Peak-to-peak voltage at Connector Pins of Transmitting		0.29	-	1.38	V	
AUX DC common mode voltage	V_{AUX-CM_RX}	0	-	2.0	V	
	V_{AUX-CM_TX}	0	-	2.0	V	
AUX AC Coupling Capacitor	C_{SOURCE_ML}	75	-	200	nF	

5.3.3 eDP HPD Signal



Parameter	Symbol	Min	Typ	Max	Unit	Notes
HPD Voltage	HPD	2.25	-	3.6	V	Sink side Driving
HOT Plug Detection Threshold		2.0	-	-	V	Source side Detecting
HOT Unplug Detection Threshold		-	-	0.8	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1.0	ms	
HPD_TimeOut	–	2.0	-	-	ms	HPD Unplug Event

6.0 SIGNAL TIMING SPECIFICATION

6.1 The MV238QHM-NF0 is operated by the DE only.

Item	Symbols		Min	Typ	Max	Unit
DCLK	Period	tCLK	1.5	1.70	3.92	ns
	Frequency	-	255	588.6	665	MHz
Horizontal Display Term	Period	tHP	2720	2760	2960	tCLK
	Horizontal Valid	tHV	2560	2560	2560	tCLK
	Horizontal Blank	tHB	160	200	400	
	Frequency	fH	71.1	213.3	244.4	KHz
Vertical Display Term	Period	tVP	1480	1481	5093	tHP
	Vertical Valid	tVV	1440	1440	1440	tHP
	Vertical Blank	tVB	40	41	3653	tHP
	Frequency	fV	48	144	165	Hz

Note 1 : 1). This DCLK range at last line of V-blanking should be set in 0~XXX.

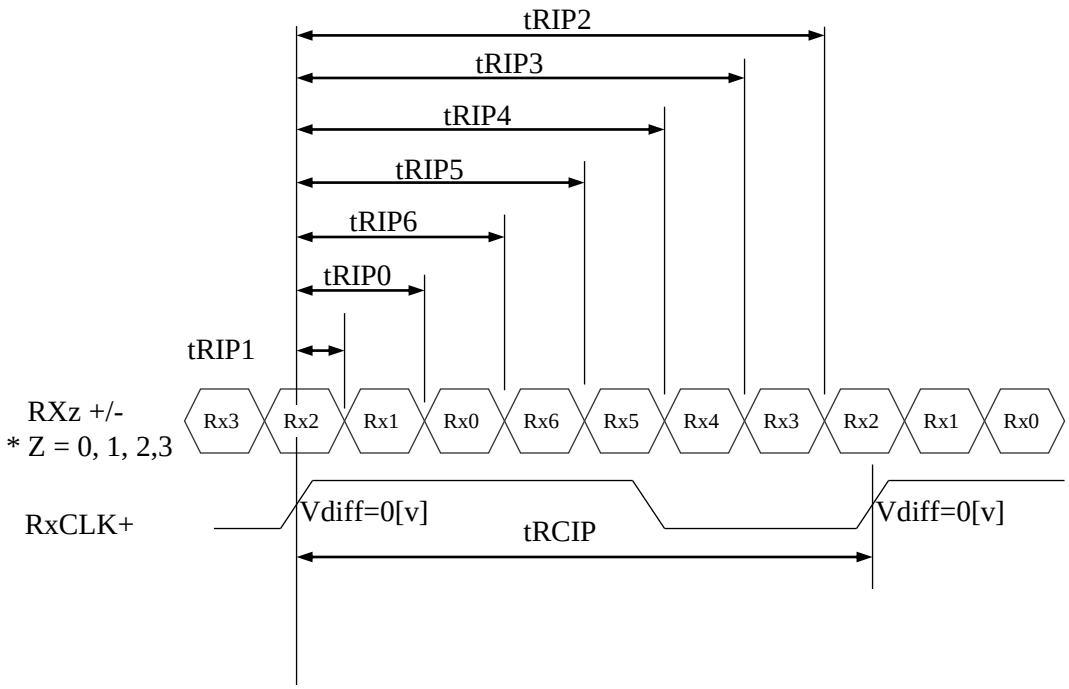
2). The Vsync Frequency maximum can reach XXHz when the resolution is applied @ 1152*900, 1280*1024.

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>

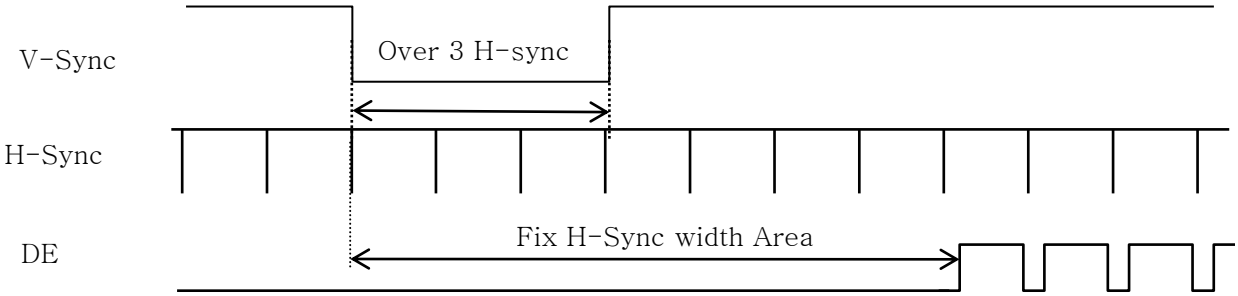
Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	12.12	16.56	20.71	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 ×tRCIP/7-0.4	2 ×tRCIP/7	2 ×tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 ×tRCIP/7-0.4	3 ×tRCIP/7	3 ×tRCIP/7+0.4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

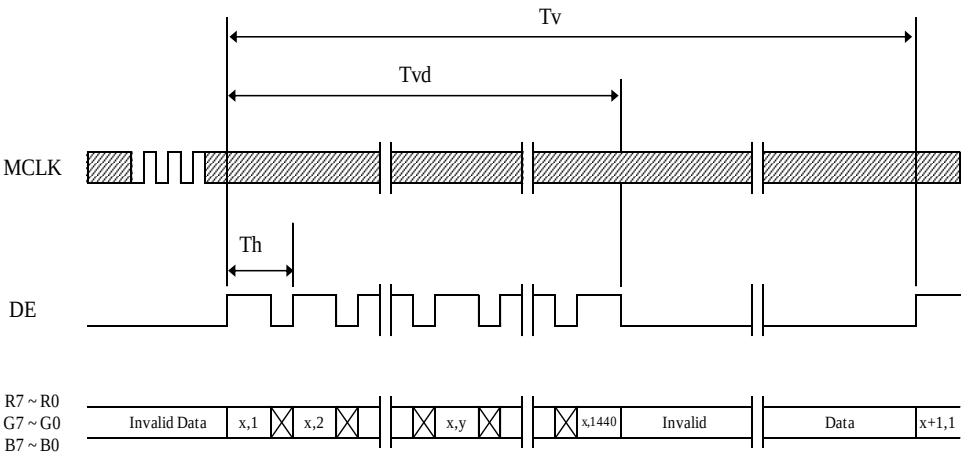
7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL

7.1 Sync Timing Waveforms

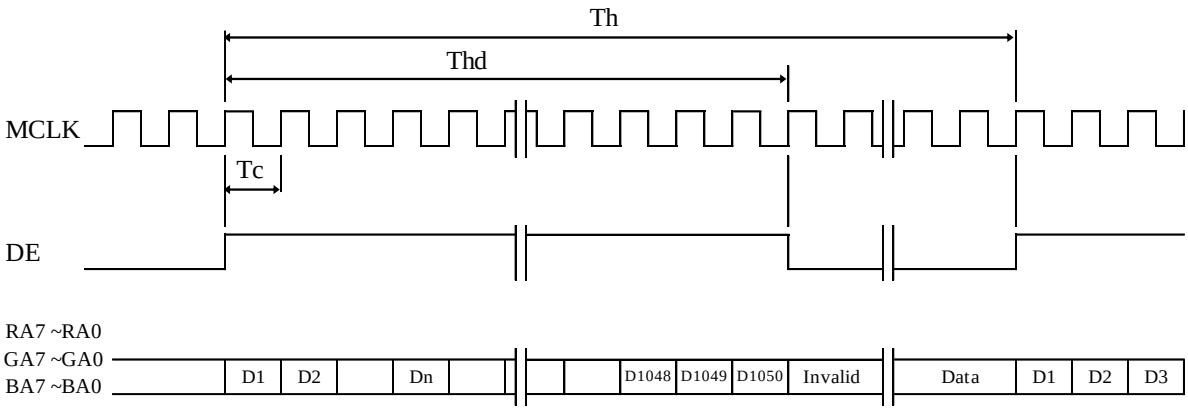


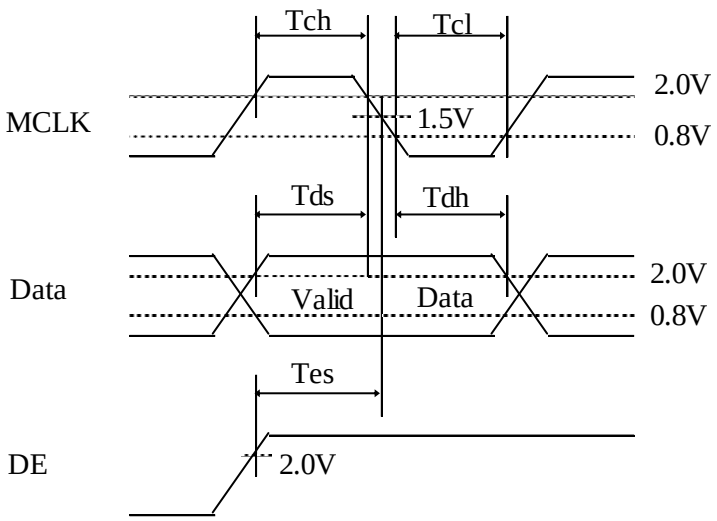
1) Need over 3 H-sync during V-Sync Low
2) Fix H-Sync width from V-Sync falling edge to first rising edge

7.2 Vertical Timing Waveforms



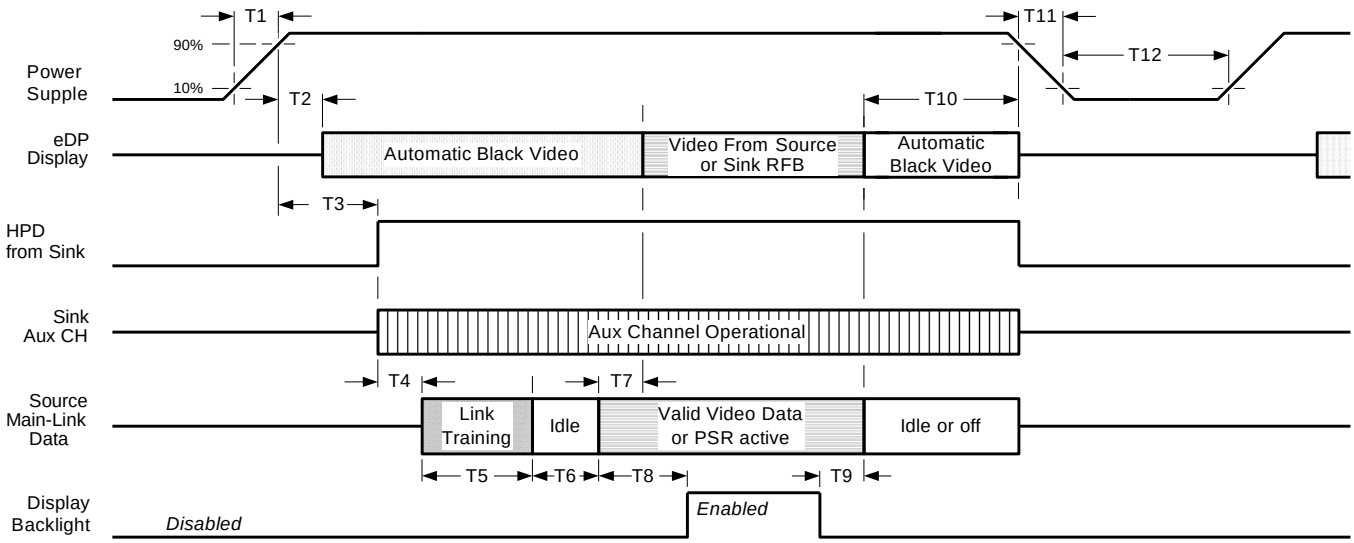
7.3 Horizontal Timing Waveforms





8.0 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.



Timing Parameter	Description	Required By	Limits		Notes
			Min	Max	
T1	Power rail rise time, 10% to 90%	Source	0.5ms	10ms	
T2	Delay from Power Supple to automatic Black Video generation	Sink	0ms	200ms	Automatic Black Video generation prevents display noise until valid video data is received from the Source
T3	Delay from Power Supple to HPD high	Sink	0ms	120ms	Sink AUX Channel must be operational upon HPD high
T4	Delay from HPD high to link training initialization	Source	-	-	Allows for the Source to read Link capability and initialize
T5	Link training duration	Source	-	-	Dependant on the Source link training protocol
T6	Link idle	Source	-	-	Min accounts for required BS-Idle Pattern. Max allows for Source frame synchronization.

8.0 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.

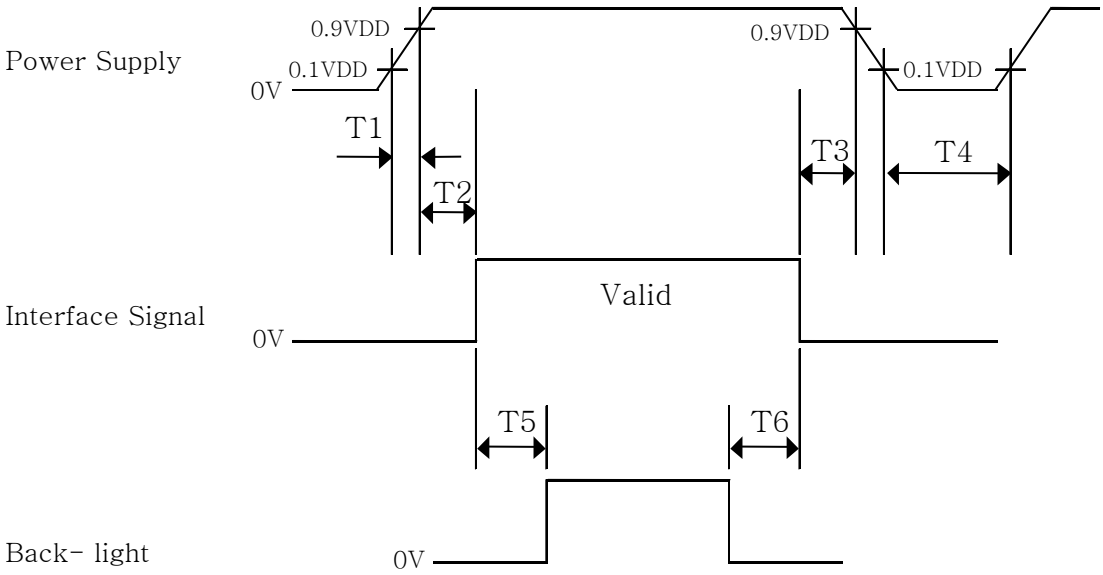
T7	Delay from valid video data from Source to video on display	Sink	0ms	50ms	Max value allows for the Sink to validate video data and timing. At the end of T7, the Sink will indicate the detection of valid video data by setting the SINK_STATUS bit to logic 1 (DPCD 00205h, bit 0), and the Sink will no longer generate automatic Black Video.
T8	Delay from valid video data from Source to backlight enable	Source	-	-	The Source must assure display video is stable
T9	Delay from backlight disable to end of valid video data	Source	-	-	The Source must assure backlight is no longer illuminated. At the end of T9, the Sink will indicate the detection of no valid video data by setting the SINK_STATUS bit to logic 0 (DPCD 00205h, bit 0), and the Sink will automatically display Black Video.
T10	Delay from end of valid video data from Source to power off	Source	0ms	500ms	
T11	Power rail fall time, 90 to 10%	Source	-	-	
T12	Power off time	Source	500ms	-	

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. T11 decreases smoothly, there is none re-bouncing voltage.

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. 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.

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	535.0 (H)×313.0(V)×12.2 (D)Typ.	mm
Weight	2260 (Typ.)	gram
Active area	526.08(H) × 295.92(V)	mm
Pixel pitch	0.2055(H) ×0.2055(V)	mm
Number of pixels	2560 (H)×1440 (V) (1 pixel = R + G + B dots)	pixels
Back-light	Horizontal arranged, 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 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 = 0℃, 240hrs	
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 100 cycle	
7	Vibration test (non-operating)	Frequency Gravity / AMP Period	Random,10 ~ 300 Hz, 30 min/Axis 1.5 Grms 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

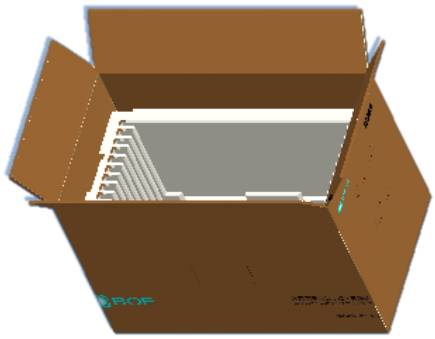
1	2	3	4	5	6	7
X X	X	X	X X	X	X X X X	X X X X X X X

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

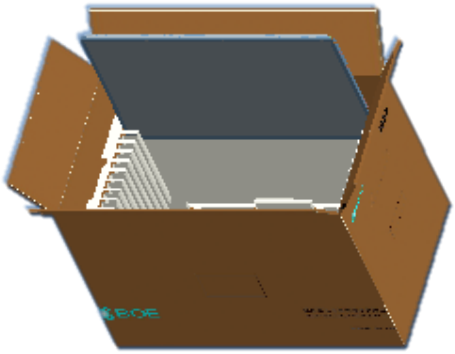
14.0 Packing

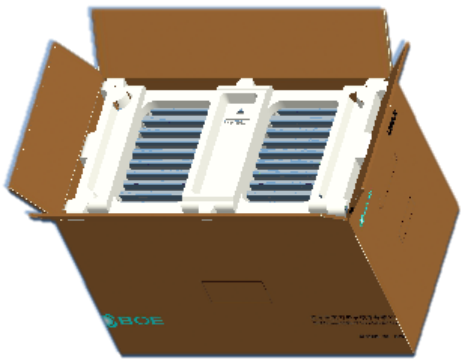
14.1 Packing Order

Put 1 EPO bottom into the inner box.

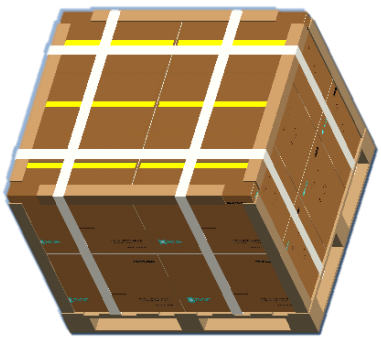


Put each module into a PE bag.
Insert 10 Pcs MDL into each box





Put 1 EPO cover in and seal the box.



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

14.2 Packing Note

- Box Dimension : 631mm(L) × 318mm(W) × 419mm(H)
- Package Quantity in one Box : 10pcs

14.3 Box label

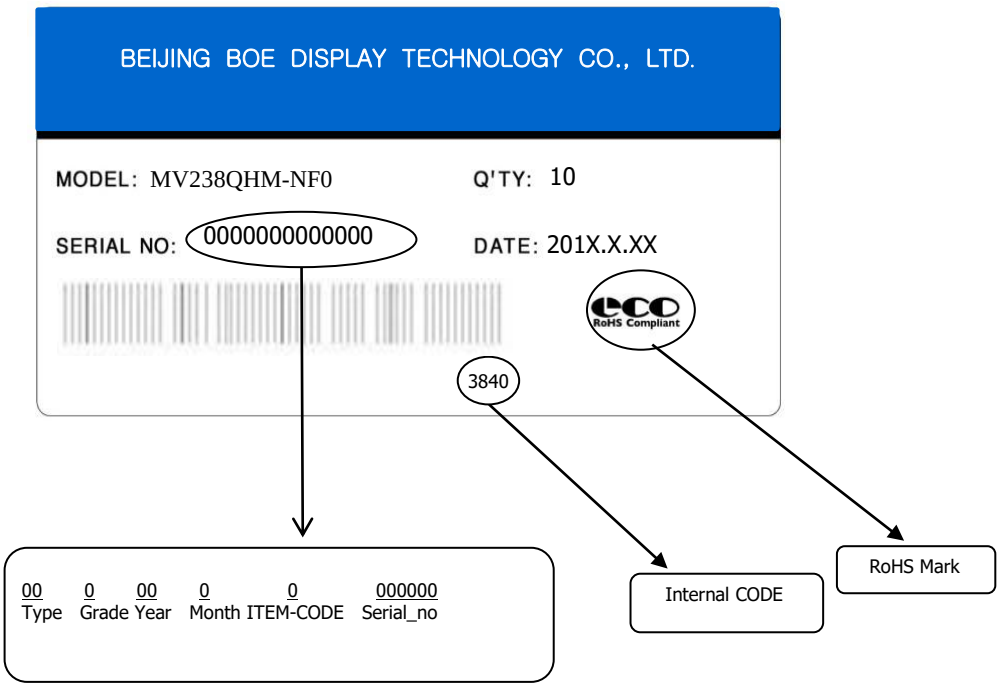
- Label Size : 108 mm (L) × 56 mm (W)
- Contents

  Model : MV238QHM-NF0

  Q`ty : Module 10  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

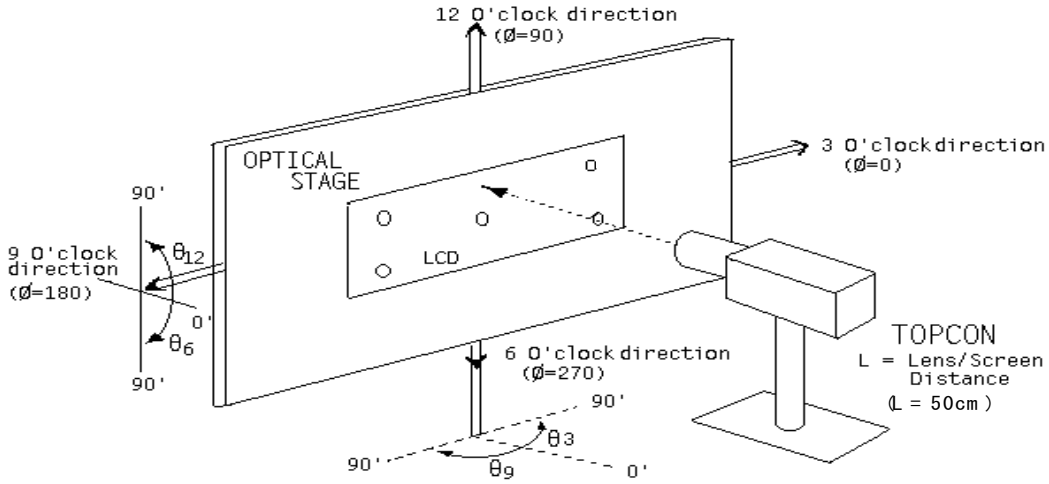


Figure 2. White Luminance and Uniformity Measurement Locations (9 points)

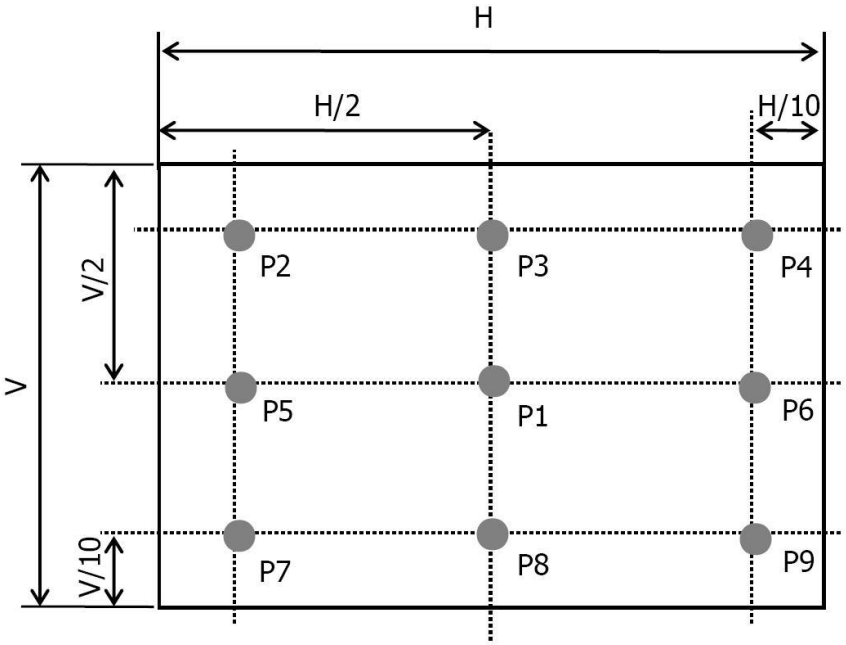


Figure 3. Response Time Testing

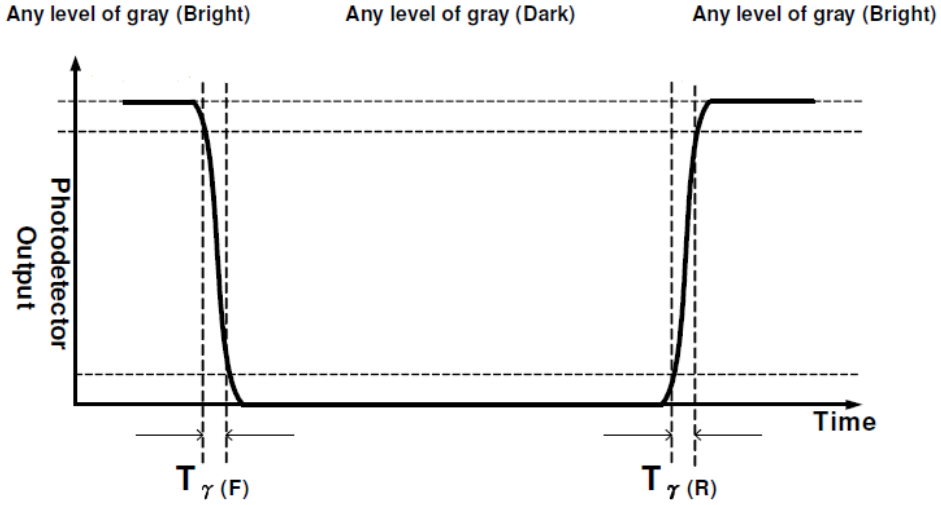
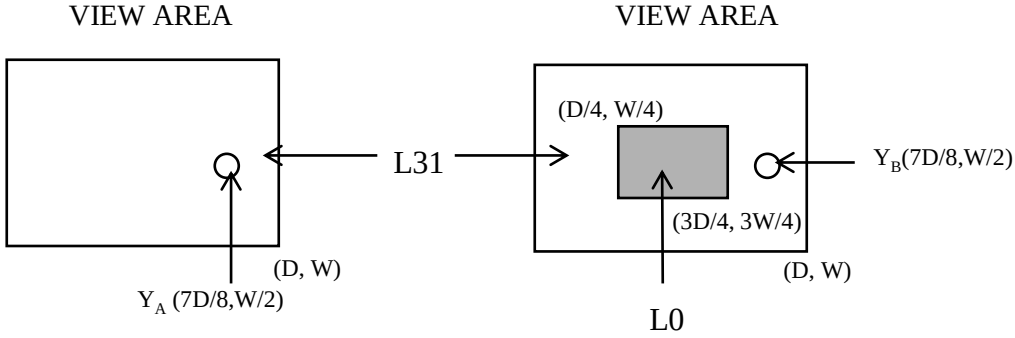


Figure 4. Cross Modulation Test Description



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

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 Module Outline Dimensions (Front view)

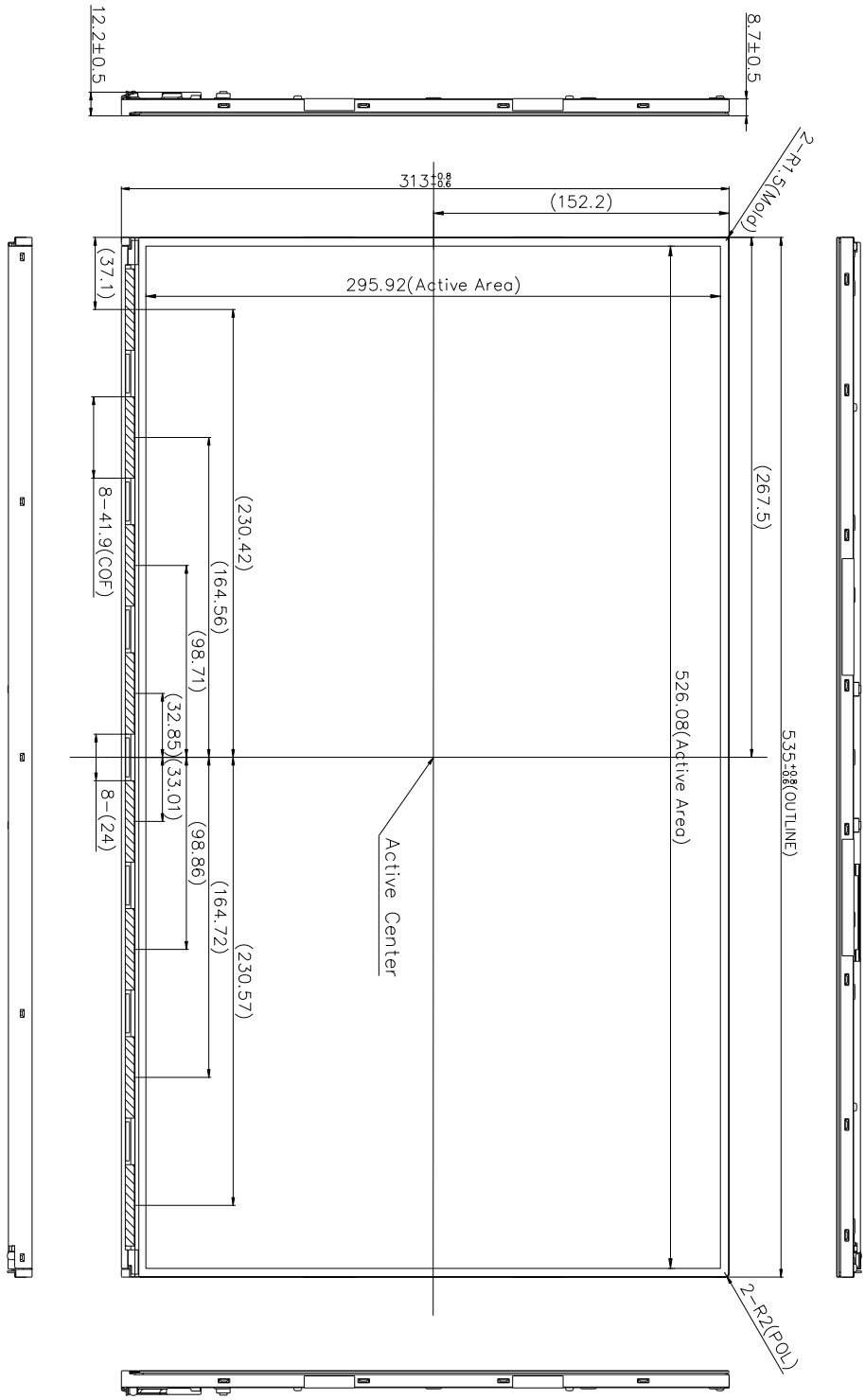
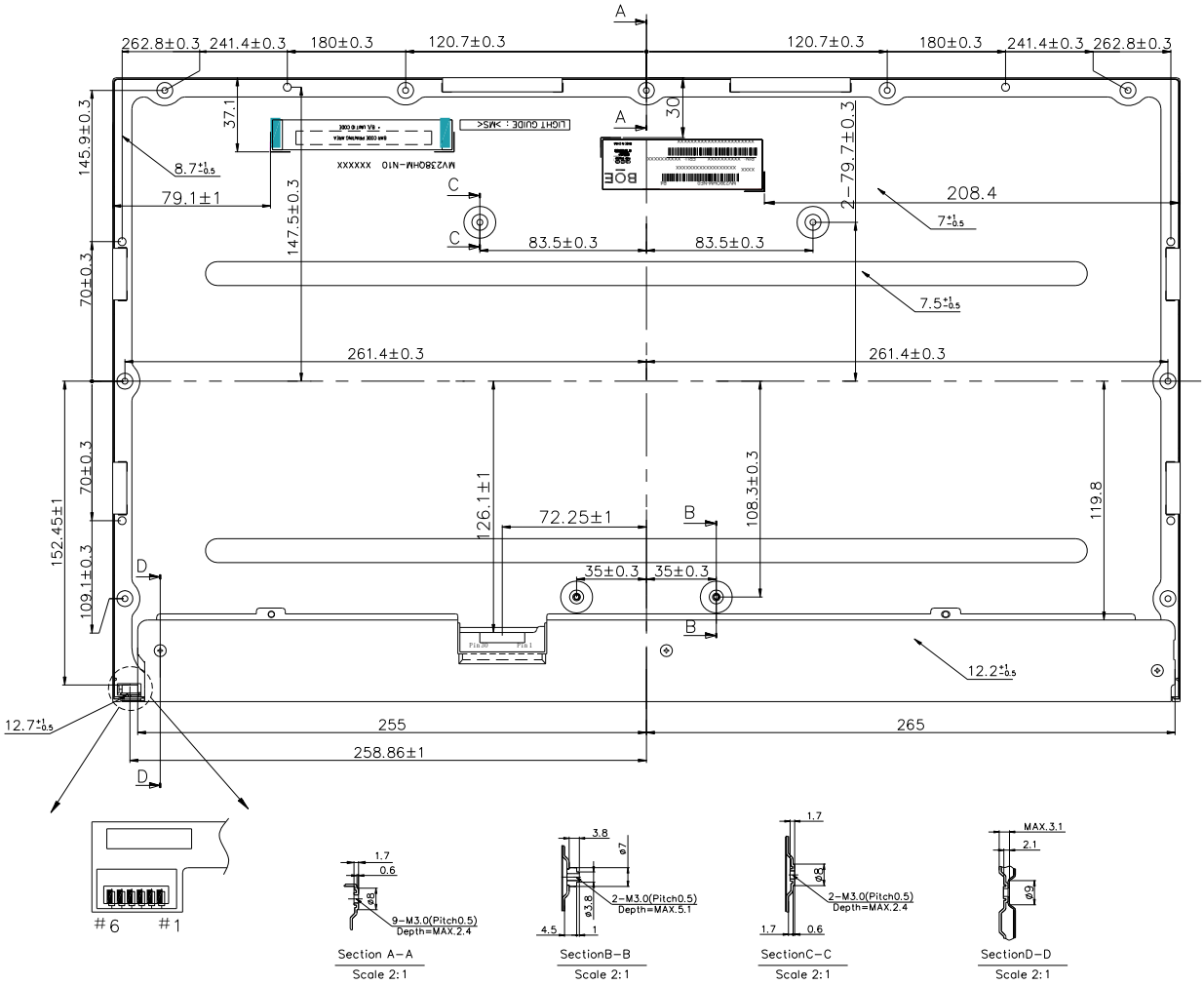
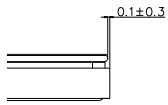


Figure 6. TFT-LCD Module Outline Dimensions (Rear view)



NOTE:

1. I/F CONNECTOR SPECIFICATION
   IS050-L30B-C10 or EQUIVALENT
2. LED CONNECTOR SPECIFICATION
   3712K-Q06C-00R(ENTERY) or BM06B-SHJS-TB(JST) or EQUIVALENT
3. USER MOUNTING TORQUE SPEC : 3 ~ 4 kgf-cm
4. Tilt and portial disposition tolerance of display area as followling
   Measuring Tool: Feeler Gauge or Vernier Caliper



5. Unspecified tolerances to be ±0.5
6. The COF area is weak &sensive, so please don't press the COF Area