SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	27.0" QHD TFT LCD

BUYER	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LM270WQ1
SUFFIX	SDA2

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE DATE
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MNT Products Engineering Dept.
LG Display Co., Ltd.

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0.0	Dec. 9. 2008	-	First Draft(Preliminary)
0.1	Jan. 15. 2009	11	Pin symbol name is changed
0.2	Jan. 22. 2009	34	Timing data of EDID is corrected
		35	Check sum value is changed from 80 to F5
0.3	Feb. 7. 2009	5	Update diagonal size (60.96 → 68.47)
		5	Update pixel pitch (0.270x0.270 → 0.2331x0.2331)
		11	Update pin configuration of 30pin CNT
		11	Change 30pin CNT (Hirose → I-PEX)
		13	Update timing table
		35	Check sum value is changed from F5 to 39
0.4	Feb. 25. 2009	5	Update outline dimension
		9	Add LED Bar Electrical Characteristics
		11	Update Backlight Interface
		18	Update Response time
		25~26	Add typo (= will be updated)
0.5	Feb. 27. 2009	11	Update LED Connector & Mating Connector
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0.6	Apr. 15. 2009	1	Change SUFFIX
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0.8	Jul. 20. 2009	8	Update Electrical Characteristics
		12	Update LED CNT pin configuration
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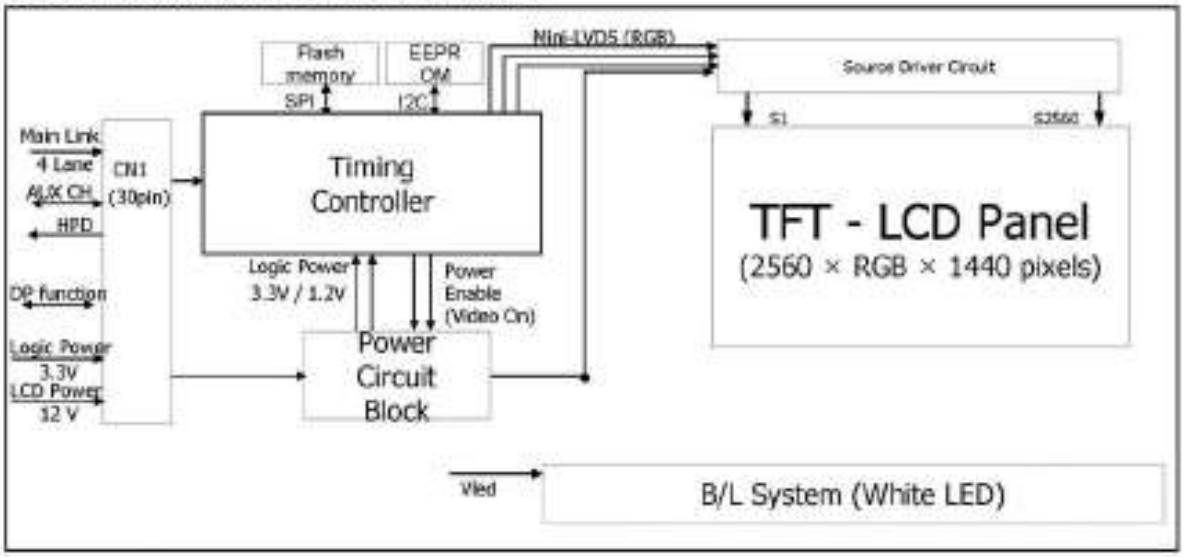
	Aug. 14. 2009	10	Update LED Bar Electrical Characteristics
1.0	Aug. 31. 2009	8~9	Update Electrical Characteristics
	Sep. 16. 2009	28	Update a mechanic drawing

1. General Description

LM270WQHD is a Color Active Matrix Liquid Crystal Display with Light Emitting Diode (White LED) backlight system without LED driver. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 27inch diagonally measured active display area with QHD resolution (2560 horizontal by 1440 vertical pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M(True) colors.
It has been designed to apply the 8Bit 4Lane Display port interface.
It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



General Features

Active Screen Size	27.0 inches(68.47cm) diagonal
Outline Dimension	630.0(H) x 376.13(V) x 21.8(D) mm(Typ.)
Pixel Pitch	0.2331 mm x 0.2331 mm
Pixel Format	2560 horiz. By 1440 vert. Pixels RGB stripes arrangement
Color Depth	8-bit, 16,777,216 colors
Luminance, White	380 cd/m² (5 points Avg.)
Viewing Angle(CR>10)	View Angle Free (R/L 178(Typ.), U/D 178(Typ.))
Power Consumption	Total 96.91 Watt (Max.) (15.36 Watt @V_{LCD}, Max 81.55 Watt_Duty 100% of DC 350 mA_w/o driver)
Weight	4600 g (typ.)
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Glare (Low Reflection treatment of the front polarizer)
HDCP	HDCP key implemented in Tcon (DP628)

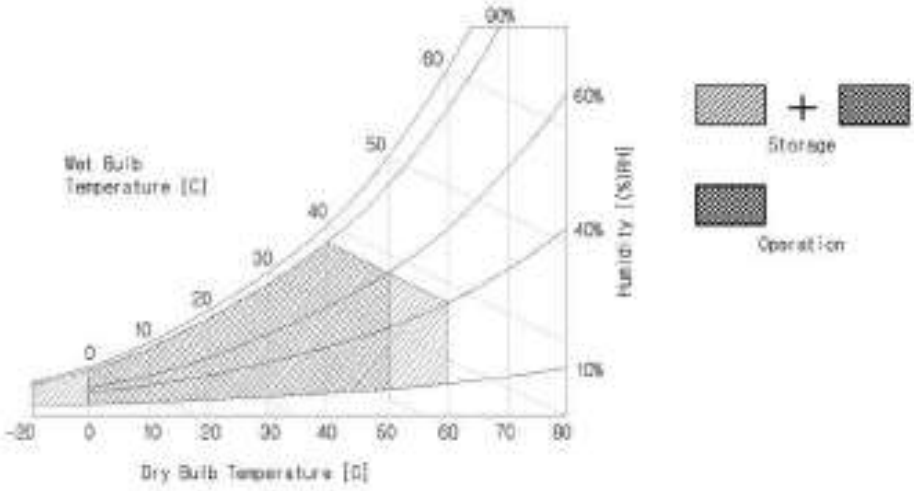
2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	V_{LCD}	-0.3	14	Vdc	at 25 ± 2°C
Power Input Voltage	$V_{OP/LOGIC}$	-0.5	4	Vdc	at 25 ± 2°C
Operating Temperature	T_{OP}	0	50	°C	1
Storage Temperature	T_{ST}	-20	60	°C	
Operating Ambient Humidity	H_{OP}	10	90	%RH	
Storage Humidity	H_{ST}	10	90	%RH	

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.



3. Electrical Specifications

3-1. Electrical Characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the DP Rx.

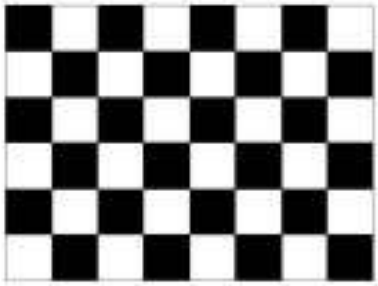
Table 2-1-1. ELECTRICAL CHARACTERISTICS (Normal Mode)

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input voltage	VLCD	11.4	12.0	12.6	Vdc	
Permissive Power Input Ripple	VdRF	-		400	mVp-p	
Power Supply Input Current	ILCD	-	890	1025	mA	1
		-	1280	1475	mA	2
Power Consumption	PLCD	-	10.68	12.30	Watt	1
			15.36	17.70	Watt	2
Rush Current	IRUSH_VLCD	-	-	3.0	A	3
DP Logic Input Voltage	VCC_DPLOGIC	3.13	3.3	3.47	Vdc	
DP Logic Input Current	I_DPLOGIC		300		mA	1
			300		mA	2
DP Logic Power Consumption	P_DPLOGIC		1.0		Watt	
DP Rush Current	IRUSH_DPLOGIC	-	-	1.0	A	3

Note :

1. The specified current and power consumption are under the V_{LCD}=12.0V, 25 ± 2°C,f_v=60Hz condition whereas mosaic pattern(8 x 6) is displayed and f_v is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 1ms(min.).

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

Maximum current pattern

White Pattern

Table 2-2. LED Bar ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	Values			Unit	Notes
			Min.	Typ.	Max.		
LED :							1,7
LED String Current	Is		-	350	700	mA	2,7
LED String Voltage	Vs		35	37.8	41	V	3,7
LED Bar Voltage	Vbar		-	226.8	233	V	3,7
LED String Power	Ps		12.25	13.23	14.35	Watt	4,6,7
LED Bar Power	Pbar		-	79.38	81.55	Watt	4,6,7
LED Life Time	LED_LT		(39,000)	-	-	Hrs	5,7
LED Junction Temperature	TJ		-	-	150	℃	7

LED driver design guide

: The design of the LED driver must have specifications for the LED in LCD Assembly.
The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.
So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.
When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.
When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

1. Specified values are for a single LED bar including Left & Right Bar.
2. The specified current is input LED chip 100% duty current.
3. The specified voltage is input LED string and Bar voltage at typical 350 mA 100% duty current.
4. The specified power consumption is input LED string & bar power consumption at typical 350 mA 100% duty current.
5. The life is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.
6. The LED bar power consumption shown above does not include loss of external driver.
   The used LED bar current is the LED typical current.
   String Power Consumption is calculated with PS = VS x Is
   Bar Power Consumption is calculated with PL = VBarx Is
7. LED operating DC Forward Current and Junction Temperature must not exceed LED Max Ratings.

3-2. Interface Connections

3-2-1. LCD Module

- LCD Connector(CN1). : FI-X30SSL-HF (manufactured by JAE)
  The pin configuration for the 30 pin connector is shown in the table below.

Table 3 MODULE CONNECTOR(CN_SIG) PIN CONFIGURATION

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	DDC_SCL	DDC for Clock	16	Lane3P	True Signal for Main Link 3
2	DDC_SDA	DDC for Data	17	Lane3N	Component Signal for Main Link 3
3	GND	High Speed Ground for Auxiliary Channel	18	GND	High Speed Ground
4	AUX_CH N	Component Signal for Auxiliary Channel	19	SPDIF	Audio output from DP RX
5	AUX_CH P	True Signal for Auxiliary Channel	20	VIDEO_ON	Video status from DP RX
6	GND	High Speed Ground for Main Link 0	21	HPD	Hot Plug Detect Signal
7	Lane0P	True Signal for Main Link 0	22	GND	GND for main power
8	Lane0N	Component Signal for Main Link 0	23	GND	GND for main power
9	GND	High Speed Ground for Main Link 1	24	GND	GND for main power
10	Lane1P	True Signal for Main Link 1	25	GND	GND for main power
11	Lane1N	Component Signal for Main Link 1	26	VLCD	12V for LCM main power
12	GND	High Speed Ground for Main Link 2	27	VLCD	12V for LCM main power
13	Lane2P	True Signal for Main Link 2	28	VLCD	12V for LCM main power
14	Lane2N	Component Signal for Main Link 2	29	VLCD	12V for LCM main power
15	GND	High Speed Ground for Main Link 3	30	VCC_L_IN	3.3V for DP TCON power

Notes : 1. Connector
2.1 Connector(Receptacle) : FI-X30SSL-HF(JAE) or 20389-Y30E-01(I-PEX)
2.2 Mating Connector(Plug) : FI-X30HL(JAE) or 20385-Y30T-12F(I-PEX)

3-2-2. Backlight Interface

- LED Connector : **H401K-D12N-12B** (Manufactured by E&T)
- Mating Connector : **4530K-F12N-01R** (Manufactured by E&T)

Table 5. LED CONNECTOR PIN CONFIGULATION

Pin No.	Symbol	Description	Note
1	L_LED1+	LED channel 1 Anode	Left bar
2	L_LED1-	LED channel 1 Cathode	
3	L_LED2+	LED channel 2 Anode	
4	L_LED2-	LED channel 2 Cathode	
5	L_LED3+	LED channel 3 Anode	
6	L_LED3-	LED channel 3 Cathode	
7	R_LED1+	LED channel 1 Anode	Right bar
8	R_LED1-	LED channel 1 Cathode	
9	R_LED2+	LED channel 2 Anode	
10	R_LED2-	LED channel 2 Cathode	
11	R_LED3+	LED channel 3 Anode	
12	R_LED3-	LED channel 3 Cathode	

3-3. Signal Timing Specifications

All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

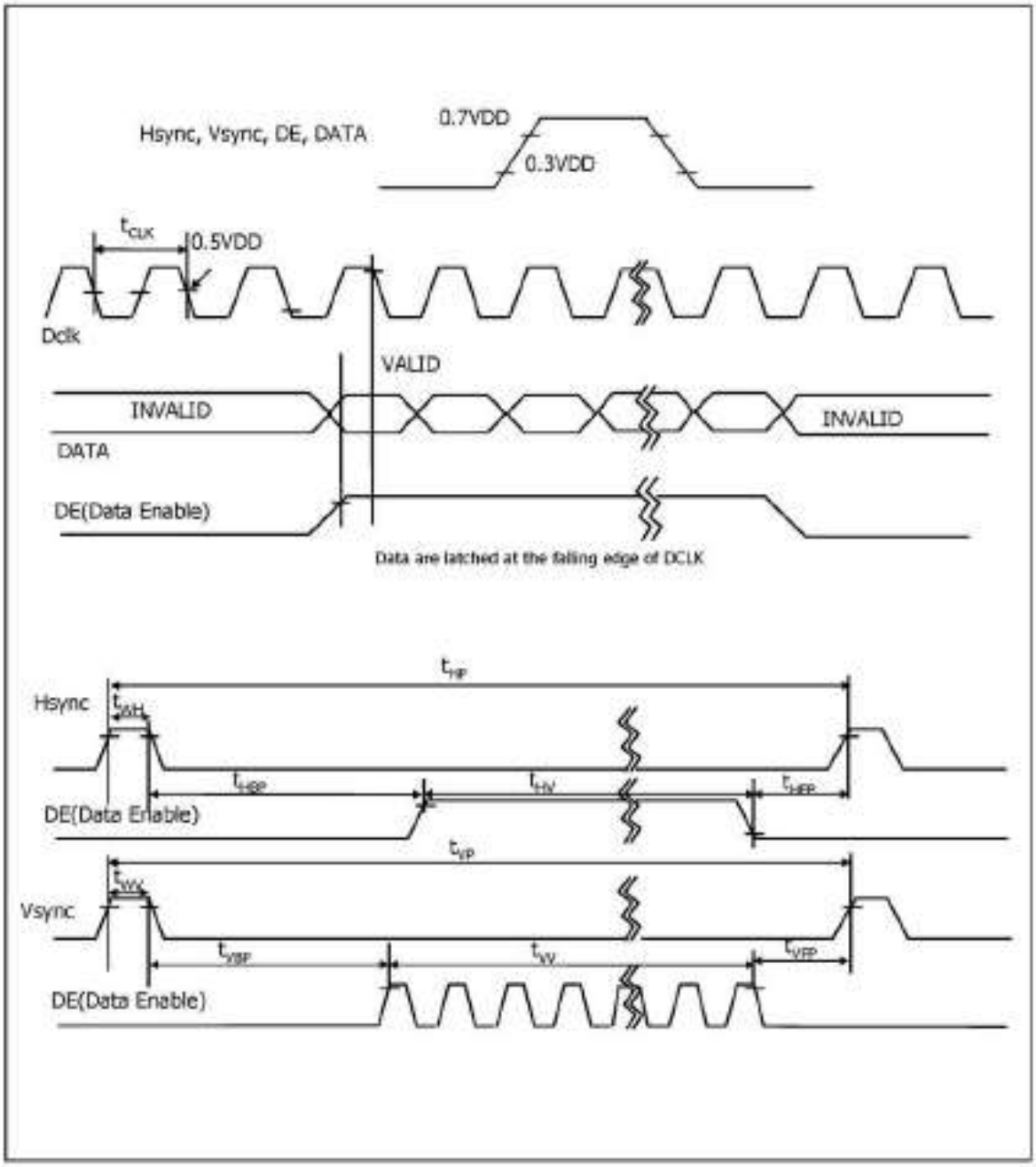
Table 6. TIMING TABLE (VESA COORDINATED VIDEO TIMING)

ITEM		SYMBOL	Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	4.14	4.14	4.14	ns	
	Frequency	fCLK	241.5	241.5	241.5	MHz	-
Hsync	Period	tHP	2720	2720	2720	tCLK	
	Width-Active	tWH	32	32	32		
Vsync	Period	tVP	1481	1481	1481	tHP	
	Frequency	fv	59.95	59.95	59.95	Hz	
	Width-Active	tWV	5	5	5	tHP	
Data Enable	Horizontal Valid	tHV	2560	2560	2560	tCLK	
	Horizontal Back Porch	tHBP	80	80	80		
	Horizontal Front Porch	tHFP	48	48	48		
	Horizontal Blank	-	160	160	160		tHW+ tHBP+ tHFP
	Vertical Valid	tVV	1440	1440	1440	tHP	
	Vertical Back Porch	tVBP	33	33	33		
	Vertical Front Porch	tVFP	3	3	3		
	Vertical Blank	-	41	41	41		tWV+ tVBP+ tVFP

Note: Hsync period and Hsync width-active should be even number times of tCLK. If the value is odd number times of tCLK, display control signal can be asynchronous. In order to operate this LCM a Hsync, Vsync, and DE(data enable) signals should be used.

1. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
2. Vsync and Hsync should be keep the above specification.
3. Hsync Period, Hsync Width, and Horizontal Back Porch should be any times of of character number(8).
4. The polarity of Hsync, Vsync is not restricted.

3-4. Signal Timing Waveforms



3-5. Color Data Reference

The Brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

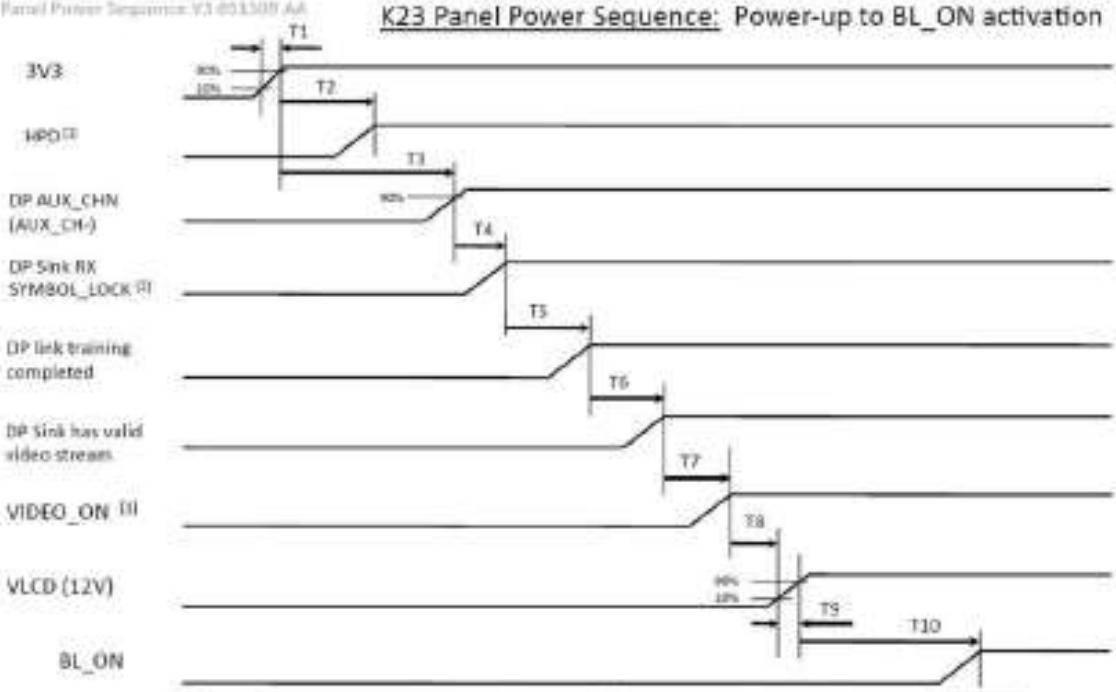
Table 7. COLOR DATA REFERENCE

Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB							LSB	MSB							LSB	MSB							LSB
		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 Color	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
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	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
	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
RED	RED (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...					...							...								...				
	RED (254)	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 (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	...					...							...								...				
	GREEN (254)	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 (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	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 (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	...					...							...								...				
	BLUE (254)	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 (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

3-6. Power Sequence

3-6-1. Power Sequence

K23 Panel Power Sequence: Power-up to BL_ON activation



Parameter	Min	Max	Units
T1	0.5	10	ms
T2	0	-	ms
T3	-	-	ms
T4	0	-	ms
T5	0	-	ms

Parameter	Min	Max	Units
T6	0	-	ms
T7	0	200	ms
T8	0	200	ms
T9	0.01	10	ms
T10	200	-	ms

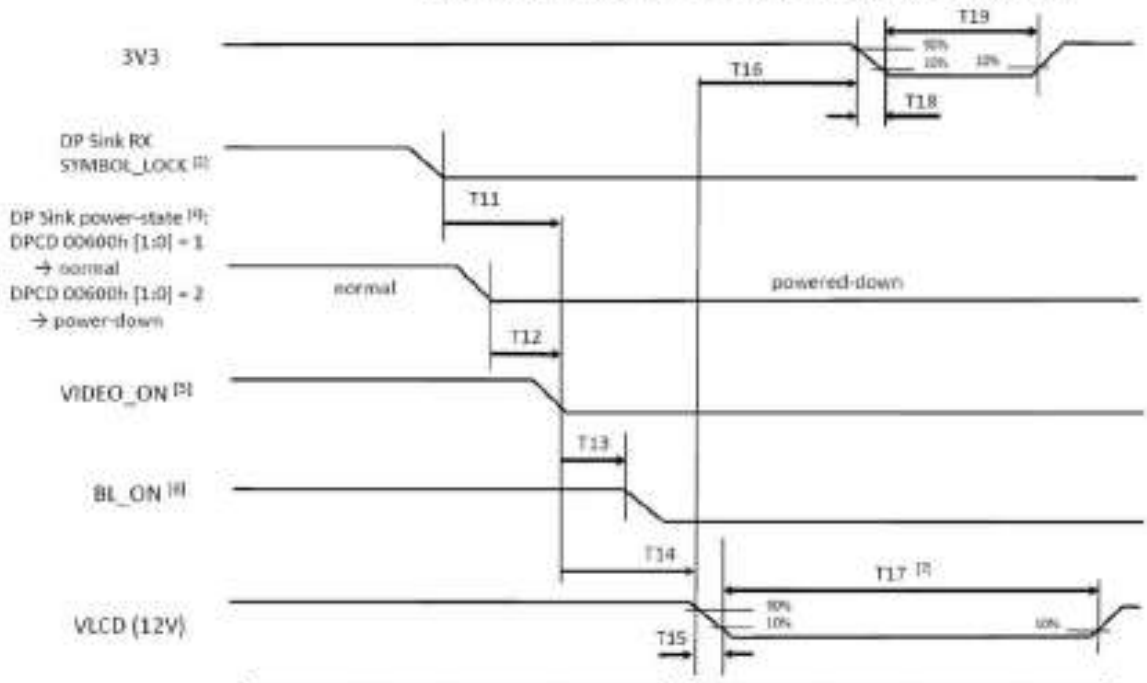
Notes : [1] HPD is asserted high by Sink at power-up
[2] SYMBOL_LOCK indicated by contents of Sink DPCD registers 00202h to 00205h
[3] VIDEO_ON asserted high by Sink when video to panel is valid

Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. LED power must be turn on after power supply for LCD and interface signal are valid.

3-6. Power Sequence

3-6-1. Power Sequence

K23 Panel Power Sequence: BL_ON de-activation



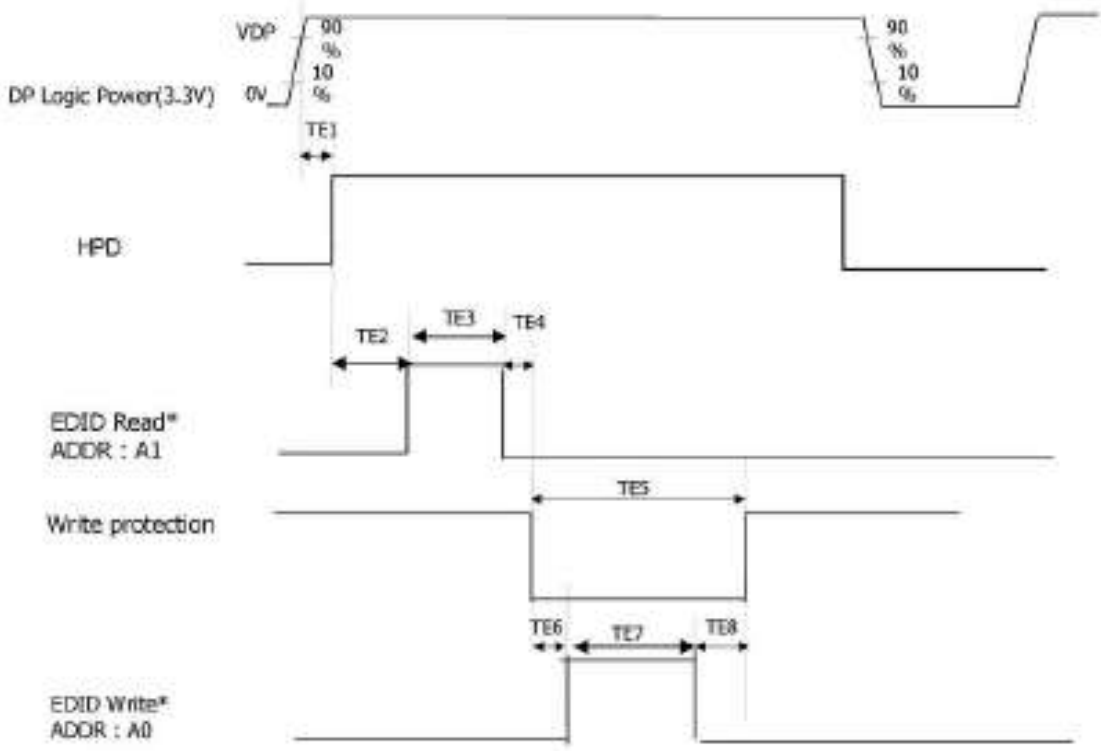
Parameter	Min	Max	Units
T11	0	10	ms
T12	0	5	ms
T13	-	10	ms
T14	10	100	ms
T15	0.01	1000	ms

Parameter	Min	Max	Units
T16	0	-	ms
T17	250	-	ms
T18	0.01	1000	ms
T19	150	-	ms

Notes : [2] SYMBOL_LOCK indicated by contents of Sink DPCD registers 00202h to 00205h
[4] Power-state set by Source in Sink DPCD register 00600h
[5] VIDEO_ON asserted low by Sink because of :
1) loss of SYMBOL_LOCK or
2) DP Sink is powered down
[6] BL_ON must be asserted low by system as rapidly as possible when video is invalid to avoid visible artifacts
[7] T17 always > T19
[8] min. times of 0 indicate precedence ordering of events, e.g. where actual timing is TBD

3-6-2. Power Sequence, EDID Read / Write

*** This timing is for fabrication purpose only, not for normal operation. ***



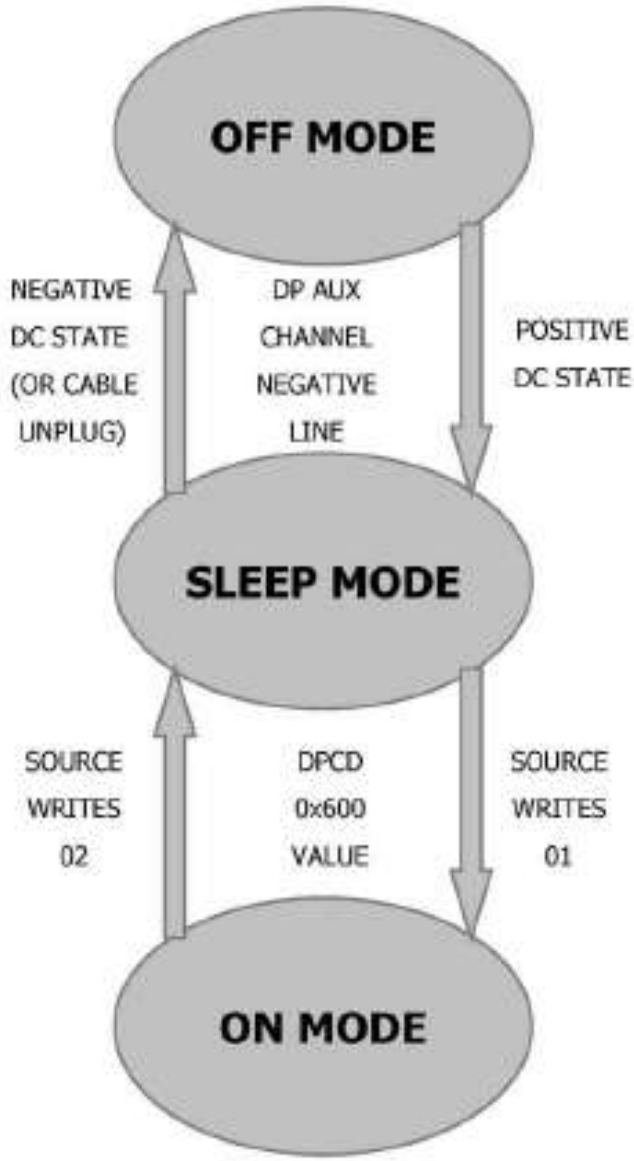
* EDID Read time and EDID write time will be exclusive.

Notes.
In case of without DP signal after DP logic power on, check HPD after TE1 time and if HPD is low status then any time can read EDID

Table 8.1 POWER SEQUENCE, EDID

Parameter	Values			Units
	Min	Typ	Max	
TE1	-	30	50	ms
TE2	1000	-	-	ms
TE3	-	30		ms
TE4	1	-	-	ms
TE5	-	-	1000	ms
TE6	1	-	-	ms
TE7	-	20	-	ms
TE8	1	-	-	ms

3-6-3. State Machine



4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 120 minutes in a dark environment at 25±2°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 ° and aperture 1 degree.
FIG. 1 presents additional information concerning the measurement equipment and method.

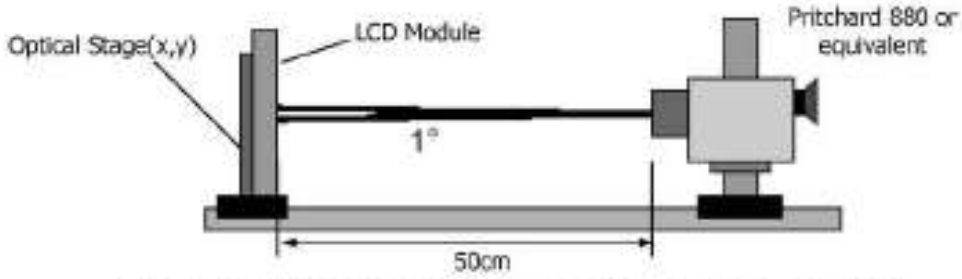


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 9. OPTICAL CHARACTERISTICS (Ta=25 °C, V_{LCD}=12.0V, f_v=60Hz Dclk=242.28MHz)

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	700	1000	-		1
Surface Luminance, white		L_{WH}	300	380	-	cd/m²	2
Luminance Variation		δ_{WHITE}			30	%	3
Response Time	Rise Time	Tr_R	-	6.5	14	ms	4.1
	Decay Time	Tr_D	-	7.5	14	ms	4.1
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.652	Typ +0.03		
		Ry		0.334			
	GREEN	Gx		0.304			
		Gy		0.619			
	BLUE	Bx		0.148			
		By		0.049			
	WHITE	Wx		0.313			
		Wy		0.329			
Color Shift	Horizontal	θ_{CST_H}	-	178	-	Degree	5
	Vertical	θ_{CST_V}	-	178	-		
Viewing Angle (CR>10)							
General	Horizontal	θ_H	170	178	-	Degree	6
	Vertical	θ_V	170	178	-		
Effective	Horizontal	θ_{GRA_H}		178	-	Degree	7
	Vertical	θ_{GRA_V}		178	-		
Gray Scale				2.2			8

Notes 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center point(Location P1)

2. Surface luminance(L_{WH})is luminance value at 5 points average across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 2.
L_{WH} = = Average[$L_{on}1, L_{on}2, L_{on}3, L_{on}4, L_{on}5$]

3. The variation in surface luminance , δ WHITE is defined as :

$$\delta_{WHITE} = \frac{\text{Maximum}(L_{on1}, L_{on2}, \ldots L_{on13}) - \text{Minimum}(L_{on1}, L_{on2}, \ldots L_{on13})}{\text{Average}(L_{on1}, L_{on2}, \ldots L_{on5})} \times 100(\%)$$

Where L1 to L13 are the luminance with all pixels displaying white at 13 locations.
For more information see FIG 2.

4. Response time is the time required for the display to transition from black to white (Rise Time, Tr_R) and from white to black (Decay Time, Tr_D). For additional information see FIG 3

5. Color shift is the angle at which the color difference is lower than 0.04.
For more information see FIG 4.
- Color difference ($\Delta u'v'$)

$$u' = \frac{4x}{-2x+12y+3} \qquad v' = \frac{9y}{-2x+12y+3}$$

$$\Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$$

u'1, v'1 : u'v' value at viewing angle direction
u'2, v'2 : u'v' value at front (Θ=0)

- Pattern size : 25% Box size
- Viewing angle direction of color shift : Horizontal, Vertical

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 5.

7. Effective viewing angle is the angle at which the gamma shift of gray scale is lower than 0.3. For more information see FIG 6 and FIG 7.

8. Gray scale specification
Gamma Value is approximately 2.2. For more information see Table 10.

Measuring point for surface luminance & measuring point for luminance variation.

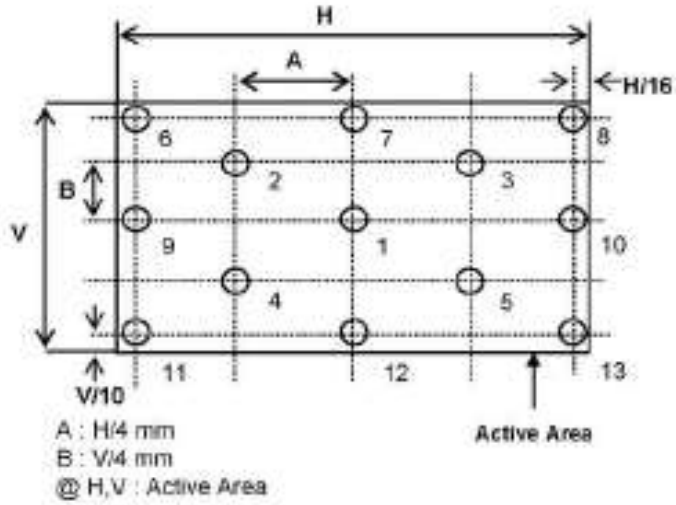


FIG. 2 Measure Point for Luminance

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

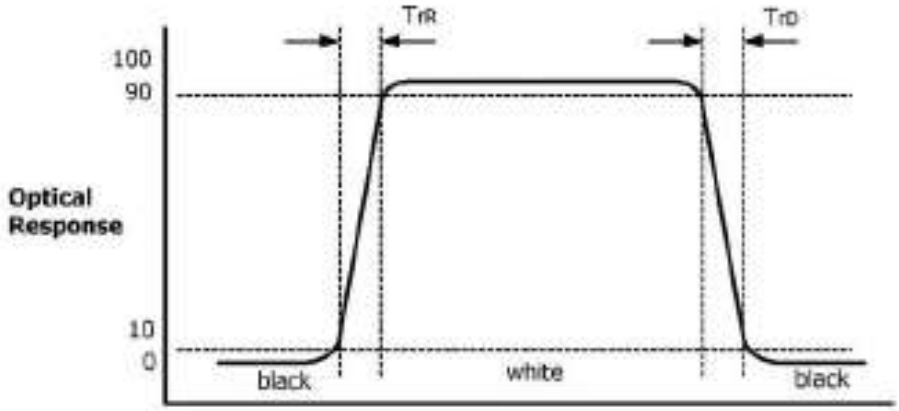


FIG. 3. Response Time

Color shift is defined as the following test pattern and color.

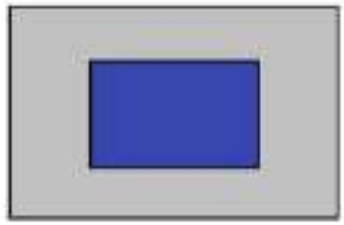


FIG. 4 Test Pattern

Average RGB values in Bruce RGB for Macbeth Chart

	Dark skin	Light skin	Blue sky	Foliage	Blue flower	Bluish green
R	98	206	85	77	129	114
G	56	142	112	102	118	199
B	45	123	161	46	185	178
	Orange	Purplish blue	Moderate red	Purple	Yellow green	Orange yellow
R	219	56	211	76	160	230
G	104	69	67	39	193	162
B	24	174	87	86	58	29
	Blue	Green	Red	Yellow	Magenta	cyan
R	26	72	197	241	207	35
G	32	148	27	212	62	126
B	145	65	37	36	151	172
	White	Neutral 8	Neutral 6.5	Neutral 5	Neutral 3.5	black
R	240	206	155	110	63	22
G	240	206	155	110	63	22
B	240	206	155	110	63	22

Dimension of viewing angle range.

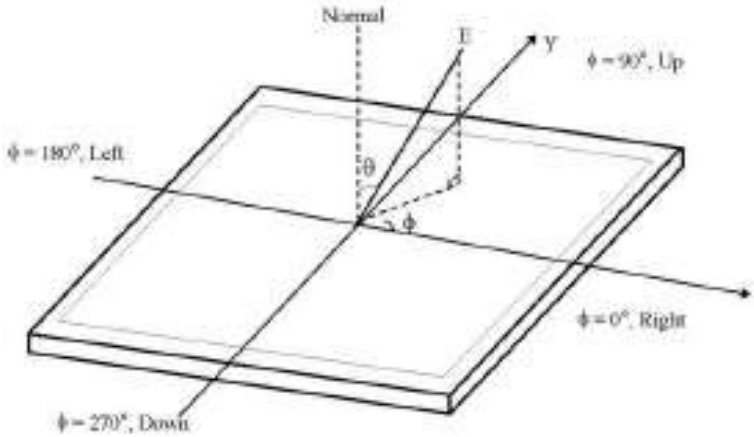


FIG. 5 Viewing angle

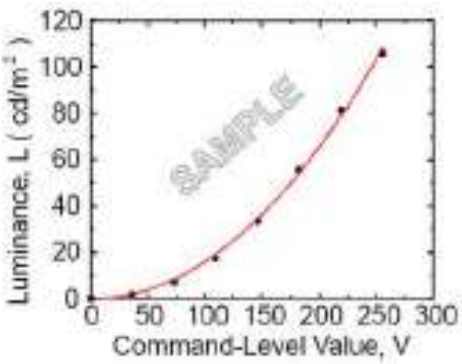


FIG. 6 Sample Luminance vs. gray scale (using a 256 bit gray scale)

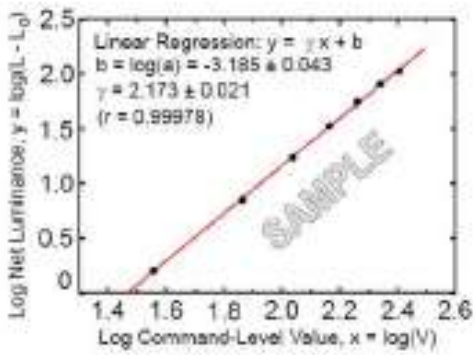


FIG. 7 Sample Log-log plot of luminance vs. gray scale

$$L = aV^{\gamma} + L_b$$

$$\log(L - L_b) = r\log(V) + \log(a)$$

Here the Parameter a and γ relate the signal level V to the luminance L.
The GAMMA we calculate from the log-log representation (FIG. 7)

Table 10. Gray Scale Specification

Gray Level	Relative Luminance [%] (Typ.)
0	0.10
31	1.08
63	4.71
95	11.5
127	21.7
159	35.5
191	53.1
223	74.5
255	100

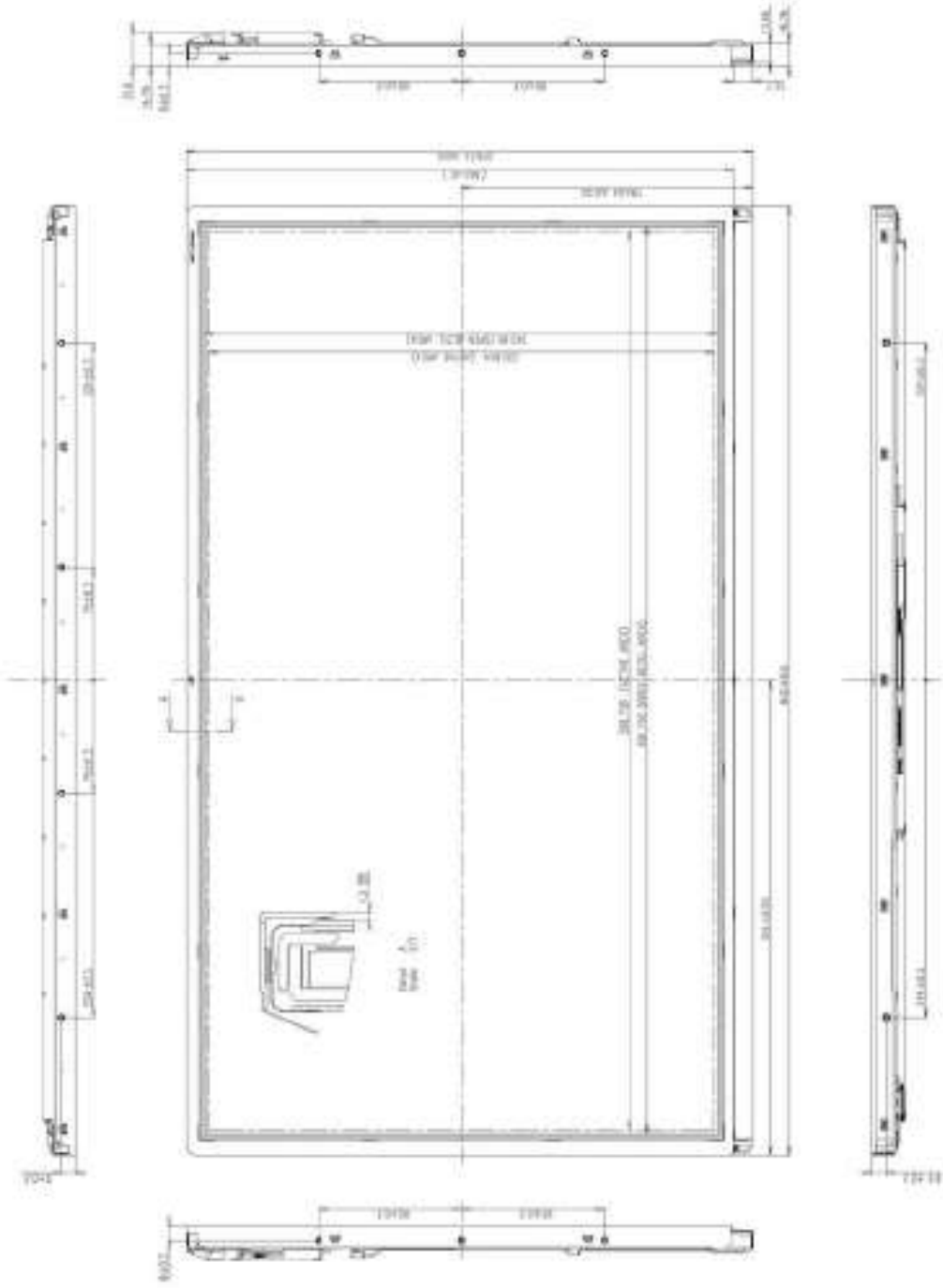
5. Mechanical Characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

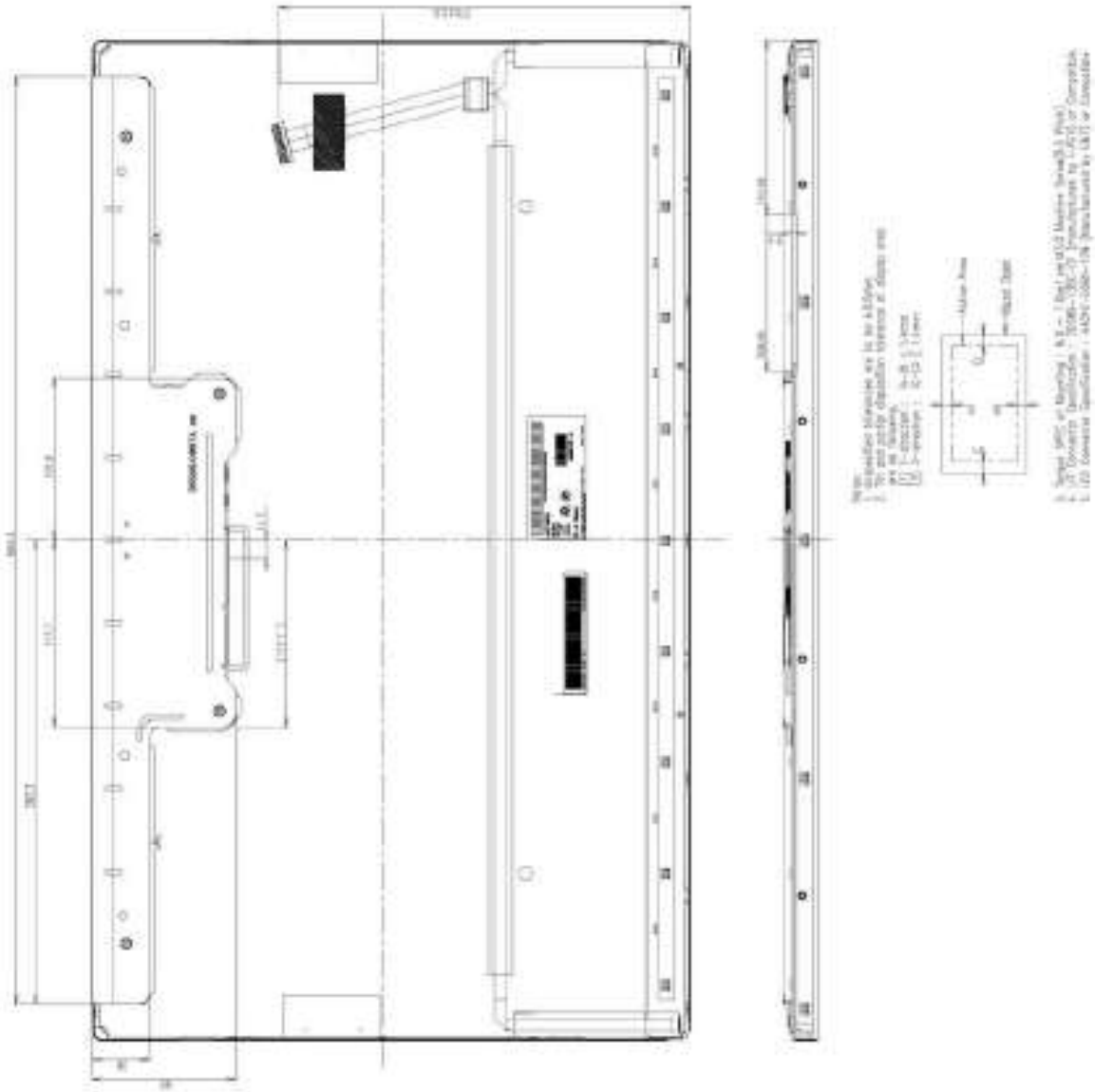
Outline Dimension	Horizontal	630.0mm
	Vertical	376.13mm
	Depth	21.8mm
Bezel Area	Horizontal	601.7mm
	Vertical	340.7mm
Active Display Area	Horizontal	596.74mm
	Vertical	335.66mm
Weight	4,600g (Typ.)	
Surface Treatment	Hard coating(2H) Glare, Low Reflection treatment of the front polarizer	

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

<FRONT VIEW>



<REAR VIEW>



6. Reliability

Environment test condition

No	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 10-300Hz Duration : X,Y,Z, 10 min One time each direction
6	Shock test (non-operating)	Shock level : 100Grms Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Altitude Operating Storage / Shipment	 0 - 10,000 feet(3,048m) 0 - 40,000 feet(12,192m)

7. International Standards

7-1. Safety

a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc.,
Standard for Safety of Information Technology Equipment.
b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association,
Standard for Safety of Information Technology Equipment.
c) EN 60950-1:2001, First Edition,
European Committee for Electrotechnical Standardization(CENELEC)
European Standard for Safety of Information Technology Equipment.
d) IEC 60950-1:2001, First Edition, The International Electrotechnical Commission (IEC)
Standard for Safety of Information Technology Equipment.
(Including report of IEC60825-1 Ed. 1.22001, clause 8 and clause 9)

7-2. EMC

a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. "American National Standards Institute(ANSI), 1992
b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998
(Including A1: 2000)

8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note
1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 7ea

b) Box Size : 747mm X 335mm X 466mm

9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

9-1. MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in four corners or four sides.
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

9-2. OPERATING PRECAUTIONS

(1) The spike noise causes the miss-operation of circuits. It should be lower than following voltage :
V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In higher temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw.
(if not, it causes metallic foreign material and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.

9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

10. EDID DATA FOR LM240WU6-SDA1

10-1. EDID Data

LM270WQ1-SDA2 EDID DATA (2560X1440 @ 60Hz)

Byte# (decimal)	Byte# (HEX)	Field Name and Comments	Value (HEX)	Value (Binary)	Value (DEC)	
0	00	Header	00	00000000	0	
1	01	Header	FF	11111111	255	
2	02	Header	FF	11111111	255	
3	03	Header	FF	11111111	255	Header
4	04	Header	FF	11111111	255	
5	05	Header	FF	11111111	255	
6	06	Header	FF	11111111	255	
7	07	Header	00	00000000	0	
8	08	EISA manufacturer code (3 Character ID), ASCII	06	00001110	6	
9	09	EISA manufacturer code (Compressed ASCII)	10	00010000	16	
10	0A	Panel Supplier Reserved - Product Code, LSB	B9	10111001	185	product ID for LM270WQ1-SDA2 =
11	0B	(Hex, LSB first)	9C	10011100	156	9CB9h
12	0C	32-bit serial #	00	00000000	0	Vendor/
13	0D		00	00000000	0	Product ID
14	0E		00	00000000	0	
15	0F		00	00000000	0	
16	10	Week of Manufacture	1C	00011100	28	
17	11	Year of Manufacture, 2009 plus	13	00010011	19	
18	12	EDID structure version # = 1	01	00000001	1	EDID Versions
19	13	EDID revision # = 4	04	00000100	4	Revision
20	14	Video input Definition = Digital/Not Bit	A5	10100101	165	
21	15	Max H image size (Rounded cm) = 60 cm	3C	00111100	60	Display
22	16	Max V image size (Rounded cm) = 34 cm	22	00100010	34	Parameter
23	17	Display gamma = (gamma*100)-100 = Example: (2.2*100)-100 =	78	01111000	120	
24	18	Feature Support (Stand-by, Suspend, Active OFF/Very Low Power, Display Color Type, Non-RGB color space, Preferred Timing Mode, GTF supported with these features)	EA	11101010	234	
25	19	Red/Green Low Bits (RxRy/GxGy)	EF	11101111	239	
26	1A	Blue/White Low Bits (BxBy/WxWy)	91	10010001	145	
27	1B	Red X Rx = 0.651	A7	10100111	167	
28	1C	Red Y Ry = 0.334	55	01010101	85	
29	1D	Green X Gx = 0.31	4C	01001100	76	Color
30	1E	Green Y Gy = 0.649	9E	10011110	158	Characteristics
31	1F	Blue X Bx = 0.146	25	00100101	37	
32	20	Blue Y By = 0.056	0C	00001100	12	
33	21	White X Wx = 0.313	50	01010000	80	
34	22	White Y Wy = 0.329	54	01010100	84	
35	23	Established timing 1 (6th, 7 not used)	00	00000000	0	Established
36	24	Established timing 2 (6th, 7 not used)	00	00000000	0	Timings
37	25	Manufacturer's timings	00	00000000	0	
38	26	Standard timing ID:1 (6th, 7 not used)	01	00000001	1	
39	27	Standard timing ID:1 (6th, 7 not used)	01	00000001	1	
40	28	Standard timing ID:2 (6th, 7 not used)	01	00000001	1	
41	29	Standard timing ID:2 (6th, 7 not used)	01	00000001	1	
42	2A	Standard timing ID:3 (6th, 7 not used)	01	00000001	1	
43	2B	Standard timing ID:3 (6th, 7 not used)	01	00000001	1	
44	2C	Standard timing ID:4 (6th, 7 not used)	01	00000001	1	Standard
45	2D	Standard timing ID:4 (6th, 7 not used)	01	00000001	1	Timing ID
46	2E	Standard timing ID:5 (6th, 7 not used)	01	00000001	1	
47	2F	Standard timing ID:5 (6th, 7 not used)	01	00000001	1	
48	30	Standard timing ID:6 (6th, 7 not used)	01	00000001	1	
49	31	Standard timing ID:6 (6th, 7 not used)	01	00000001	1	
50	32	Standard timing ID:7 (6th, 7 not used)	01	00000001	1	
51	33	Standard timing ID:7 (6th, 7 not used)	01	00000001	1	
52	34	Standard timing ID:8 (6th, 7 not used)	01	00000001	1	
53	35	Standard timing ID:8 (6th, 7 not used)	01	00000001	1	
54	36	Detailed timing/monitor	5A	01011010	90	
55	37	Pixel Clock = 241.5 MHz	97	10010111	151	
56	38	Hor. active 2560 pixels	00	00000000	0	
57	39	Hor. blanking (80 pixels)	A0	10100000	160	
58	3A		A0	10100000	160	
59	3B	Vertical active (1440 lines)	A0	10100000	160	
60	3C	Vertical blanking = 46 lines	2E	00101110	46	Detailed
61	3D		60	01100000	96	Timing
62	3E	H sync. Offset = 48 pixels	30	00110000	48	Description
63	3F	H sync. Width = 32 pixels	20	00100000	32	#1
64	40	V sync. Offset = 3 lines	32	00110010	50	
65	41	V sync. Width = 5 lines	50	01010000	80	
66	42	H image size = 597 mm	54	01010100	84	
67	43	V image size = 336 mm	90	10010000	144	
68	44		20	00100000	32	
69	45	No Horizontal Border	00	00000000	0	
70	46	No Vertical Border	00	00000000	0	
71	47	Non-interlace, Normal display, no stereo, Digital Separate (Sync -ve, Sync -ve)	18	00011000	24	

72	48	1280x720 Timing	1A	00011010	26
73	49	Pixel Clock = 74.5 MHz	2D	00101101	45
74	4A	Horizontal Active = 1280 Pixels	00	00000000	0
75	4B	Horizontal Blanking = 344 Pixels	80	10000000	128
76	4C		51	01010001	81
77	4D	Vertical Active = 720 Lines	D0	11010000	208
78	4E	Vertical Blanking = 20 Lines	1C	00011100	28
79	4F		20	00100000	32
80	50	Horizontal Sync. Offset = 64 Pixels	40	01000000	64
81	51	Horizontal Sync Pulse Width = 128 Pixels	80	10000000	128
82	52	V sync. Offset=3 lines	33	00110101	55
83	53	V sync. Width= 5 lines	00	00000000	0
84	54	H image size= 017 mm	01	01010101	85
85	55	V image size = 101 mm	50	01010000	80
86	56		21	00100001	33
87	57	No Horizontal Border	00	00000000	0
88	58	No Vertical Border	00	00000000	0
89	59	Non-interlace, Normal display, no stereo, Digital Separate (Horiz. NEG, Vert. P	1C	00011100	28
90	5A	Detailed timing descriptor	00	00000000	0
91	5B	descriptor #3	00	00000000	0
92	5C		00	00000000	0
93	5D		02	00000010	2
94	5E		04	00000100	4
95	5F		06	00000110	6
96	60		30	00110000	48
97	61		01	00000001	1
98	62		0A	00001010	10
99	63		01	00000001	1
100	64		00	00000000	0
101	65		00	00000000	0
102	66		00	00000000	0
103	67		00	00000000	0
104	68		00	00000000	0
105	69		00	00000000	0
106	6A		00	00000000	0
107	6B		00	00000000	0
108	6C	Detailed timing descriptor	00	00000000	0
109	6D	descriptor #4	00	00000000	0
110	6E	Color LCD	00	00000000	0
111	6F		FC	11111100	252
112	70		00	00000000	0
113	71	C	43	01000011	67
114	72	o	6F	01101111	111
115	73	l	6C	01101100	108
116	74	o	6F	01101111	111
117	75	r	72	01110010	114
118	76		20	00100000	32
119	77	L	4C	01001100	76
120	78	C	43	01000011	67
121	79	D	44	01000100	68
122	7A		0A	00001010	10
123	7B		20	00100000	32
124	7C		20	00100000	32
125	7D		20	00100000	32
126	7E	Extension Flag = 01	01	00000001	1
127	7F	Checksum	08	00001000	8
128	80	Tag	02	00000010	2
129	81	Revision Number	03	00000011	3
130	82	Offset of first Detailed Timing Description	0C	00001100	12
131	83	Device Support & No. of Native Formats	C1	11000001	193
132	84	Audio Data Block Tag	23	00100011	35
133	85	CEA Short Video Descriptor 1	09	00001001	9
134	86	Audio Data Block Tag	7	00000111	7
135	87	CEA Short Audio Descriptor 1	07	00000111	7
136	88	Speaker Allocation Data Block Tag	83	10000011	131
137	89	Speaker Allocation Payload	01	00000001	1
138	8A		00	00000000	0
139	8B		00	00000000	0
140	8C	Detailed timing descriptor	7E	01111110	126
141	8D	Pixel Clock = 241.5 MHz	5E	01011110	94
142	8E	Hor. active= 2560 pixels	00	00000000	0
143	8F	Hor. blankings= 160 pixels	A0	10100000	160
144	90		A0	10100000	160
145	91	Vertical active= 1440 lines	A0	10100000	160
146	92	Vertical blankings= 41 lines	29	00101001	41

Detailed Timing Description #2

Detailed Timing Description #3

Ascii Data String

Detailed Timing Description #4

Monitor Name: Color LCD

Extension Flag

Checksum

10-2. EDID DATA READ/WRITE PROTOCOL

10-2-1. READ Operation

<Start><Slave Address, RW=0><Byte Address><Start><Slave Address, RW=1><Data><Stop>

10-2-2. WRITE Operation

<Start><Slave Address, RW=0><Byte Address><Data><Stop>

- **Device Address** (Slave Address)

Type	Device (Slave) Address								Hex
IS24C02B	1	0	1	0	0	0	0	RW	0xA0 + RW

- **Byte Address**

Byte Address	
Decimal	0 ~ 127
Hex	0x00 ~ 0x7F