

SPECIFICATION FOR APPROVAL

() Preliminary Specification

() Final Specification

Title

30" WQXGA TFT LCD

BUYER	
MODEL	

SUPPLIER	LG.Philips LCD CO., Ltd.
*MODEL	LM300W01
SUFFIX	A3

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



APPROVED BY	DATE
S.G.Hong / G.Manager	
REVIEWED BY	
P.Y.Kim / Manager	
PREPARED BY	
D.Y.Kim / Engineer	
Product Engineering LG. Philips LCD Co.	Dept.



CONTENTS

NO.	ITEM	Page
-	COVER	1
-	CONTENTS	2
-	RECORD OF REVISIONS	3
1	GENERAL DESCRIPTION	4
2	ABSOLUTE MAXIMUM RATINGS	5
3	ELECTRICAL SPECIFICATIONS	6
3-1	ELECTRICAL CHARACTERISTICS	6
3-2	INTERFACE CONNECTIONS	8
3-3	SIGNAL TIMING SPECIFICATIONS	12
3-4	SIGNAL TIMING WAVE FORMS	14
3-5	COLOR INPUT DATA REFERANCE	15
3-6	POWER SEQUENCE	16
4	OPTICAL SPECIFICATIONS	18
5	MECHANICAL CHARACTERISTICS	23
6	RELIABILITY	26
7	INTERNATIONAL STANDARDS	27
7-1	SAFETY	27
7-2	EMC	27
8	PACKING	28
8-1	DESIGNATION OF LOT MARK	28
8-2	PACKING FORM	28
9	PRECAUTIONS	29



RECORD OF REVISIONS

Revision No	Data	Page	Description
Ver. 1.0	Jul. 20, 2004		Final Specifications

LG.PHILIPS LCD

Product Specification

1. General Description

The LM300W01 LCD is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) back light system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 30.0 inch diagonally measured active display area with WQXGA resolution(2560 vertical by 1600 horizontal 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 luminance of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,777,216 colors.

The LM300W01 has been designed to apply the Dual TMDSTM(Transition Minimized differential Signaling) as the interface method to enables a simple and low-cost implementation in both the host and monitor.



Figure 1. Block diagram

General Features

Active screen size	30.0 inches (756.228mm) diagonal
Outline Dimension	677.30(H) x 436.80(V) x 42.30(D) mm(Typ.)
Pixel Pitch	0.2505 mm x 0.2505 mm
Pixel Format	2560 horizontal By 1600 vertical Pixels. RGB stripe arrangement
Color Depth	8-bit, 16,777,216 color
Luminance, White	280 cd/m ² (5 points Avg.)
Viewing Angle(CR>10)	Viewing Angle Free(R/L 176(Typ.), U/D 176(Typ.))
Power Consumption	Total 106.5 Watt(Typ.), (11.5 Watt @V _{LCD} , 95 Watt @280cd/[Lamp=5mA])
Weight	5,100 g (Typ.)
Display Operating Mode	Transmissive mode, normally Black
Surface Treatments	Hard coating (3H), Anti-glare treatment of the front polarizer

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

Doromotor	Symbol	Valu	ies	Unito	Notes	
Falameter		Min.	Max.	Units		
Power Supply Input Voltage for Panel	V _{LCD}	-0.3	21.0	V _{dc}	At 25 ℃ ± 2°C	
Operating Temperature	T _{OP}	0	50	Ĵ	1	
Storage Temperature	T _{ST}	-20	60	Ĵ		
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

🕞 LG.PHILIPS LCD 🅰

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 CCFL, is typically generated by an inverter. The inverter is an external unit to the LCDs.

Product Specification

Table 2. Electrical Characteristics

Porometer	Symphol		Values	Linit	Notoo	
Falameter	Symbol	Min	Тур	Max	Unit	NOICES
MODULE :						
Power Supply Input Voltage	VLCD	17.0	18.0	19.0	Vdc	
Permissive Power Input Ripple	VdRF			400	mV _{p-p}	
Device Current Januar Current	ILCD	540	640	740	mA	1
Power Supply Input Current		-	810	1040	mA	2
Power Consumption	PLCD	-	11.5	13.3	Watt	1
Rush current	Irush	-	-	4	А	3

Note :

- 1. The specified current and power consumption are under the V_{LCD}=18.0V, $25 \pm 2^{\circ}C$, 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.).





Mosaic Pattern(8 x 6)

Maximum current pattern



White Pattern

[Figure 3] Mosaic pattern : for power consumption measurement

Table 3. INVERTER Electrical Characteristics

Deremeter	Symbol	Condition		Values	Linit	Notoo	
Parameter	Symbol	Condition	Min.	Тур.	Max.	Unit	notes
Inverter :							
Input Voltage	V _{BL}		21.6	24.0	26.4	V	1
Input Current	I _{BL}	$V_{BR} = 3.3V$		3.65	4.2	А	2
Input Power	PBL	$V_{BR} = 3.3V$		88.0	100	Watt	2
B/L on/off control	Von/off	Lamp ON = High	2.0	-	5.0	V	
		Lamp OFF =Low	0.0	-	0.8	V	
Brightness Adj	Vbr		0	-	3.3	V	
LAMP :							
Life time			50,000			Hrs	3

Notes :

1. The input voltage ripple is limited below 400mVp-p.

2. The specified current and power consumption are under the typical supply Input voltage, 24V.

- 3. The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at $25 \pm 2^{\circ}$ C.
- 4. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 30min in a dark environment at 25 °C \pm 2°C.

3-2. Interface Connections

This LCD employs three kinds of interface connections. A 30-pin connector is used for TMDS signals from the host computer. A 15-pin connector is used for LCD module power and LCM controls signal from external monitor control circuits. And 14-pin connector is used for the inverter for backlight system.

3-2-1. Signal Interface

The Dual TMDS signal interface connector is FI-XL30SSL-HF(manufactured by JAE) or equivalent. The pin configuration for the 30 pin connector is shown in the table below.

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	GND	NC	16	RxC-	TMDS negative differential output(Channel C)
2	GND	NC	17	SHLD5	Shield for TMDS Channel 5
3	GND	NC	18	Rx5+	TMDS positive differential output(Channel 5)
4	GND	NC	19	Rx5-	TMDS negative differential output(Channel 5)
5	SHLD2	Shield for TMDS Channel 2	20	SHLD4	Shield for TMDS Channel 4
6	Rx2+	TMDS positive differential output(Channel 2)	21	Rx4+	TMDS positive differential output(Channel 4)
7	Rx2-	TMDS negative differential output(Channel 2)	22	Rx4-	TMDS negative differential output(Channel 4)
8	SHLD1	Shield for TMDS Channel 1	23	SHLD3	Shield for TMDS Channel 3
9	Rx1+	TMDS positive differential output(Channel 1)	24	Rx3+	TMDS positive differential output(Channel 3)
10	Rx1-	TMDS negative differential output(Channel 1)	25	Rx3-	TMDS negative differential output(Channel 3)
11	SHLD0	Shield for TMDS Channel 0	26	GND	NC
12	Rx0+	TMDS positive differential output(Channel 0)	27	GND	NC
13	Rx0-	TMDS negative differential output(Channel 0)	28	GND	NC
14	SHLDC	Shield for TMDS Channel C	29	GND	NC
15	RxC+	TMDS positive differential output(Channel C)	30	GND	NC

Table 4. 30Pin Connector pin configuration(For Dual Link TMDS)

Notes: 1. Interface Chips

- : Sil163B x 2ea (Dual TMDS Receiver ,Silicon Image)
- 2. Connector
 - 2.1 Connector(Receptacle) : FI-X30SSL-HF(JAE) or Equivalent.
 - 2.2 Mating Connector(Plug) : FI-X30H and FI-X30HL or its equivalent.



3-2-2.Power Connector

The power connector is 53261 (manufactured by Molex) or equivalent. The pin configuration for the 15 pin connector is shown in the table below.

Pin	Symbol	Description	Notes
1	GND	Ground	
2	Save_Control	Open	Reserved
3	PWR_ON	LCM ON control signal input	
4	GND	Ground	
5	V _{LCD}	LCM power supply, +18V $\pm5\%$	
6	V _{LCD}	LCM power supply, +18V $\pm5\%$	
7	V _{LCD}	LCM power supply, +18V $\pm5\%$	
8	V _{LCD}	LCM power supply, +18V $\pm5\%$	
9	GND	Ground	
10	NC	Open	Reserved
11	NC	Open	Reserved
12	GND	Ground	Reserved(AGP)
13	HS_OUT	Hsync Output	
14	VS_OUT	Vsync Output	
15	PS_ON	Dual / Single mode Output	High3.3V) :Dual Low(0V) :Single

Notes: 1. Connector

1) Connector(Receptacle) : 53261 (Molex) of Equivalent.

2) Mating Connector(Plug) : 51021 or its equivalent.

Constant



[Figure 4] Connector diagram



Notes:

- 1. All GND(ground) pins should be connected together and should also be connected to the LCD's metal frame.
- 2. All power input pins should be connected together.
- 3. All NC pins should be separated from other signal or power.

3-2-3. Inverter Connector for Backlight

The inverter connector is S14B-PH-SM3(manufactured by JST) or equivalent The pin configuration for the 14 pin connector is shown in the table below.

Table 6. 14Pin Connector Pin Configuration (Inverter Connector)

Pin	Symbol	Description	Notes
1	V _{BL}	Power Supply, +24V	
2	V _{BL}	Power Supply, +24V	
3	V _{BL}	Power Supply, +24V	
4	V _{BL}	Power Supply, +24V	
5	V _{BL}	Power Supply, +24V	
6	GND	Power Ground	
7	GND	Power Ground	
8	GND	Power Ground	
9	GND	Power Ground	
10	GND	Power Ground	
11	VS	No connection	
12	V _{ON}	BL On/Off Control signal	ON : 2.0V~5.0V OFF : 0.0~0.8V
13	V _{BR}	PWM Dimming Control Signal	Max3.3V/Min0.0V
14	Status	Lamp Operating Status	Normal =0~0.8∨ Abnormal= 3.0~5.0∨

1. Connector

1) Connector(Receptacle) : S14B-PH-SM3 (JST) or equivalent

2) Mating Connector(Plug) : PHR14 or its equivalent



Rear view of LCM

3-3. Signal Timing Specifications

This is the signal timing required at the input of the TMDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

ITEM SYMBOL Min Тур Max Unit Note 7.45 Period 7.45 7.45 ns t_{CLK} DCLK 268.5/2 Frequency 134.25 134.25 134.25 MHz **f**_{CLK} (Dual) Width-Total tнт 2720 2720 2720 **t**CLK Period 10.13 us t_{HP} Hsync Frequency fн 98.71 KHz --Width 32 twн -**t**CLK Width-Total 1646 1646 1646 t_{VT} t_{HP} Period 16.68 t_{VP} Vsync Frequency fv 59.97 Hz Width 6 tw∨ _ _ t_{HP} Horizontal Valid 2560 2560 2560 t_{HV} Horizontal Back Porch 80 t_{HBP} t_{CLK} Horizontal Front Porch 48 t_{HFP} Horizontal Blank _ 160 twn+ t_{HBP}+ t_{HFP} Data Enable Vertical Valid 1600 1600 1600 t_{VV} Vertical Back Porch t_{VBP} _ 38 t_{HP} 2 Vertical Front Porch t_{VFP} Vertical Blank 46 twv+ tVBP+ tvFP

|--|

PS ON : High

- 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, Vsyn, 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 character number(8).
 - 4. The polarity of Hsync, Vsync is not restricted.

Table 8. TIMING TABLE 2 (Single mode: 1280x800)

PS ON : Low

ITEM		SYMBOL	Min	Тур	Max	Unit	Note
	Period	t _{CLK}	14.08	14.08	14.08	ns	
DOLK	Frequency	f _{CLK}	71.00	71.00	71.00	MHz	Single
	Width-Total	t _{HP}	1440	1440	1440	t _{CLK}	
Hourse	Period	t _{HP}	-	20.28	-	us	
- HSync	Frequency	fн	-	49.31	-	KHz	
	Width	t _{WH}	-	32	-	t _{CLK}	
Vsync	Width-Total	t _{VT}	823	823	823	t _{HP}	
	Period	t _{VP}	-	16.69	-	ms	
	Frequency	f _V	-	59.91	-	Hz	
	Width	t _{WV}	-	6	-	t _{HP}	
	Horizontal Valid	t _{HV}	1280	1280	1280		
	Horizontal Back Porch	t _{HBP}	-	80	-	t _{CLK}	
	Horizontal Front Porch	t _{HFP}	-	48	-		
Data	Horizontal Blank	-	-	160	-		t _{WH} + t _{HBP} + t _{HFP}
Enable	Vertical Valid	t _{V V}	800	800	800		
	Vertical Back Porch	t _{VBP}	-	15	-		
	Vertical Front Porch	t _{VFP}	-	2	-	L _{HP}	
	Vertical Blank	-	-	23	-		t _{WV} + tV _{BP} + t _{VFP}

Notes :

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 are may be influenced by variance of the vertical refresh rates.
- 2. Vsync, Hsync should be keep the above specification.
- 3. Hsync Period should be a double number of character (8).
- 4. The polarity of Hsync, Vsync is not restricted.



3-4. Signal Timing Waveforms



3-5. Color Input Data Reference

The brightness of each primary color (red,green and 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 9. COLOR DATA REFERENCE

											Inp	out	Со	lor	Da	ita									
	Color	M:	SB		Re	ed			SB	M:	SB		Gre	en			SB	M:	SB		Blu	ue			SB
		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 Red (255) Green (255) Blue (255) Cyan Magenta Yellow White	0 1 0 0 1 1	0 1 0 0 1 1 1	0 1 0 0 1 1	0 1 0 0 1 1 1	0 1 0 0 1 1	0 1 0 0 1 1 1	0 1 0 0 1 1	0 1 0 0 1 1 1	0 1 0 1 0 1 1	0 1 0 1 0 1	0 1 0 1 0 1	0 1 0 1 0 1 1	0 1 0 1 0 1	0 1 0 1 0 1	0 1 0 1 0 1	0 1 0 1 0 1	0 0 1 1 1 0	0 0 1 1 1 0	0 0 1 1 1 1	0 0 1 1 1 1 1	0 0 1 1 1 0	0 0 1 1 1 0	0 0 1 1 1 0	0 0 1 1 1 0
Red	Red(000) Dark Red(001) Red(002) Red(253) Red(254) Red(255) Bright	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 1 - 0 1 1	0 1 0 - 1 0 1	0 0 - - 0 0 0	0 0 - - 0 0	0 0 - 0 0 0	0 0 - - 0 0 0	0 0 - - 0 0	0 0 - - 0 0	0 0 - - 0 0	0 0 - - 0 0 0	0 0 - - 0 0 0	0 0 - - 0 0	0 0 - - 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
Green	Green(000) Dark Green(001) Green(002) Green(253) Green(254) Green(255) Bright	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 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 1 - 0 1	0 1 0 - 1 0 1	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
Blue	Blue(000) Dark Blue(001) Blue(002) Blue(253) Blue(254) Blue(255) Bright	0 0 0 0 0 0	0 0 - - 0 0 0	0 0 0 0 0 0	000-000	0 0 0 0 0 0	0 0 0 0 0 0	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 - 1 1	0 0 1 - 0 1 1	0 1 0 - 1 0 1										



3-6. Power Sequence for Panel



Table 10. Power Sequence

Deremeter		Values	Units	Notes	
Parameter	Min. Typ.		Max.		
T1	-		30	ms	
T2	-	-	-	ms	
Т3	-		300	ms	
T4	100		-	ms	
T5	-		80	ms	
T6	-		80	ms	
T7	400		-	ms	
Т8	50		-	ms	
Т9	-		10	ms	

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. Lamp power must be turn on after power supply for LCD and interface signal are valid.



3-6. Power Sequence for Inverter



Table 11. Power Sequence

Doromotor		Values	Units	Notos		
Parameter	Min.	Ain. Typ. Max.		Units	NOLES	
T1	1	-	30	ms		
T2	200	-	-	ms		
Т3	-	-	50	ms		
T4	500	-	-	ms		
T5	-	-	10	ms		

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are measured at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

Figure. 5 presents additional information concerning the measurement equipment and method.



[Figure 5] Optical characteristic measurement equipment and method

Table 12. Optical characteristic	(Ta=25±2°C, V _{LCD} =18V, f _V =60Hz, CLK=134.25MHz, I _{OUT} =5mA)

Parameter		Sumbol		Values	Linita	Notaa	
Parame	ter	Symbol	Min	Тур	Max	Units	notes
Contrast Ratio		CR	300	400			1
Surface Luminance,	white	L _{WH}	220	280		cd/m ²	2
Luminance Variation	1	δ_{WHITE}		30	35	%	3
	Rise Time	Tr _R	-	9	15	ms	4
Posponso Timo	Decay Time	Tr _D	-	7	15	ms	4
Response mille	Gray To Gray	T _{GTG_AVR}	-	12	-	ms	5
	Glay TO Glay	T _{GTG_MAX}	-	18	-	ms	5
	RED	Rx		0.640			
Color Coordinates [CIE1931]		Ry		0.343			
	GREEN	Gx		0.292			
		Gy	Тур	0.611	Тур +0.03		
	BLUE	Bx	-0.03	0.146			
		Ву		0.074			
	WHITE	Wx		0.313			
		Wy		0.331			
Color shift	Horizontal	$\theta_{\text{CST}_{\text{H}}}$	-	176	-	degree	6
Color Shift	Vertical	θ_{CST_V}	-	176	-		
Viewing Angle (CR>	10)						
gonoral	Horizontal	θ_{H}	170	176	-	dograa	7
general	Vertical	θ_{V}	170	176	-	degree	1
Effective	Horizontal	θ_{GMA_H}	-	176	-	degree	8
	Vertical	θ_{GMA_V}	-	176	-		0
Gray Scale				2.2			9



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

Contrast Ratio = Surface Luminance with all white pixels Surface Luminance with all black pixels

- Surface luminance 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_{nn}1, L_{nn}2, L_{nn}3, L_{nn}4, L_{nn}5]
- 3. The variation in surface luminance , δ WHITE is defined as :

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

Measuring point for surface luminance & measuring point for luminance variation



FIG. 2 Measure Point for Luminance



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

Response time is the time required for the display to transition from black to white (Rise Time, TrR) and from white to black (Decay Time, TrD).



FIG. 3 Response Time

- 5. **The Gray to Gray response time** is defined as the following figure and shall be measured by switching the input signal for "Gray To Gray ".
 - Gray step : 5 Step
 - $T_{GTG AVR}$ is the total average time at rising time and falling time for "Gray To Gray ".

- $T_{GTG MAX}$ is the max time at rising time or falling time for "Gray To Gray ".

Gray to Gray		Rising Time							
		G255	G191	G127	G63	G0			
Falling Time	G255								
	G191								
	G127								
	G63								
	G0					\sim			

v'=

- 6. Color shift is the angle at which the color difference is lower than 0.04.
 - Color difference($\triangle u'v'$)

$$u' = \frac{4x}{-2x + 12y + 3}$$
$$\Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$$

9y -2x + 12y +3

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



Viewing angle direction

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
В	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
В	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
В	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
В	240	206	155	110	63	22



7. Viewing angle(general) is the angle at which the contrast ratio is greater than 10.



8. Effective viewing angle is the angle at which the gamma shift of gray scale is lower than 0.3.

Here the Parameter α and γ relate the signal level V to the luminance L.

The GAMMA we calculate from the log-log representation (Fig. 2)

9. Gray scale specification

Gamma Value is approximately 2.2. For more information see Table 8.

	Table 8.	Gray	Scale	Specification
--	----------	------	-------	---------------

Gray Level	Relative Luminance [%] (Typ.)
0	0.3
31	1.2
63	4.68
95	11.7
127	21.2
159	35.2
191	53.0
223	75.4
255	100

10. TCO '03 item regarding Display characteristic is satisfied.

 $L = aV^r + L_h$



5. Mechanical Characteristics

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

Table 14. Mechanical characteristics

	Horizontal	677.30 mm		
Outline Dimension	Vertical	436.80 mm		
	Depth	42.30 mm		
Dezel Aree	Horizontal	646.30 mm		
Bezel Alea	Vertical	405.80 mm		
	Horizontal	641.28 mm		
Active Display Area	Vertical	400.8 mm		
Weight	5100g (Typ.), 5400g (Max.)			
Surface Treatment	Hard coating(3H) Anti-glare(13%) 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 : 10-500Hz Duration : X,Y,Z, 10 min One time each direction
6	Shock test (non-operating)	Shock level : 100G Waveform : half sine wave, 2ms Direction : $\pm X$, $\pm Y$, $\pm Z$ One time each direction
7	Altitude operating storage / shipment	0 - 10,000 feet(3048m) 0 - 40,000 feet(12,192m)



7. International Standards

7-1. Safety

- a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000. Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000. Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
- c) EN 60950 : 2000, Third Edition
 IEC 60950 : 1999, Third Edition
 European Committee for Electrotechnical Standardization(CENELEC)
 EUROPEAN STANDARD for Safety of Information Technology Equipment Including
 Electrical Business Equipment.

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,B,C : Inch

D : Year

E : Month

F : Panel Code

G : Factory Code

H : Assembly Code

I,J,K,L,M : Serial No

Note

1. Year

Year	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
Mark	7	8	9	0	1	2	3	4	5	6	7

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	А	В	С

3. Panel Code

Panel Code	P1 Factory	P2 Factory	P3 Factory	P4 Factory	P5 Factory	Hydis Panel
Mark	1	2	3	4	5	Н

4. Factory Code

Factory Code	LPL Gumi	LPL Nanjing
Mark	К	С

5. Serial No

Serial No.	1 ~ 99,999	100,000 ~
Mark	00001 ~ 99999	A0001 ~ A9999, , Z9999

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 : 4 pcs
- b) Box size : 853mm X 497mm X 557mm.



9. Precautions

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

9-1. Mounting Precautions

- (1) You must mount a module using holes (refer 24~25 page)
- (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 a 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 describe 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 determined 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 mis-operation of circuits. It should be lower than following voltage : $V=\pm 200 \text{mV}(\text{Over and under shoot voltage})$
- (2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower 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 not be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal 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 or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.