

Product Specification

LG Electronics Inc.

Date : 13. Apr. 1996

LP104S2

Customer's Acceptance Specifications.

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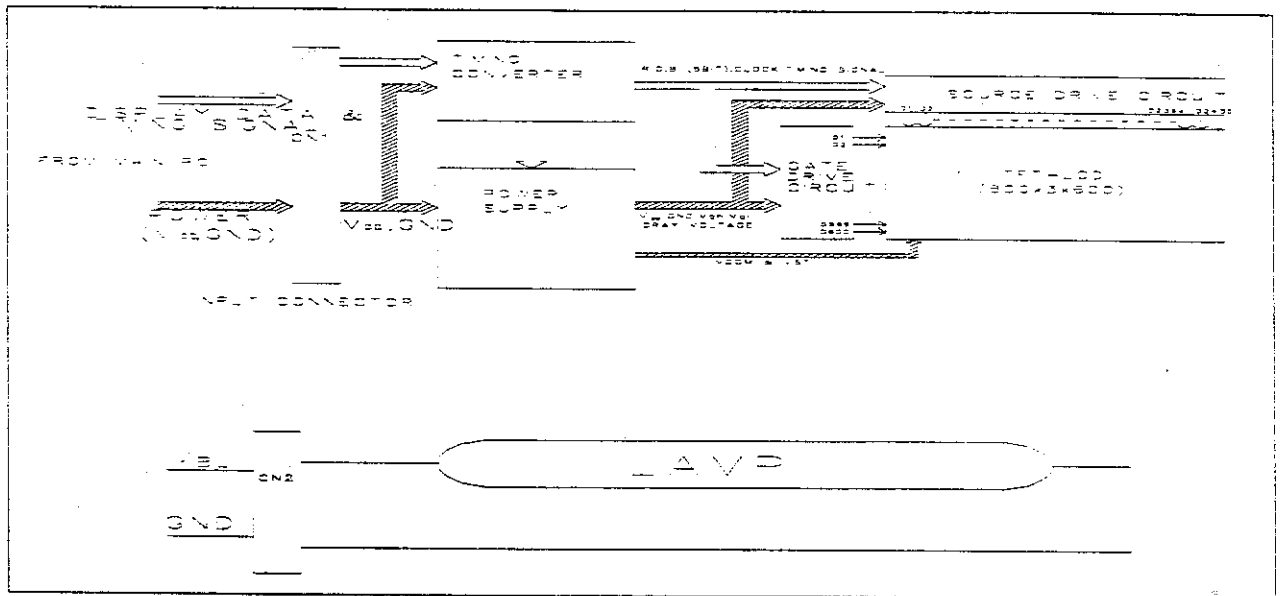
Record of Revision

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1. General Description

The LG Electronics model LCA4SE12A LCD is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Tube(CCFT) 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 white mode. This TFT-LCD has a 10.4 inch diagonally measured active display area with SVGA resolution(600 vertical by 800 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 brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,000 colors.

The LCA4SE12A LCD is intended to support applications where low power consumption, weight and thickness are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LCA4SE12A characteristics provide an excellent flat panel display for office automation products such as portable computers.



General Display Characteristics

The following are general feature of the model LCA4SE12A LCD;

Active display area	10.4 inches(26cm) diagonal
Outside dimensions	246.5w * 179.4h * 8.5t mm
Pixel pitch	0.264 mm * 0.264 mm
Pixel format	800 horiz. By 600 vert. pixels
	RGB stripe arrangement
Color depth	6-bit, 262,140 colors
Display operating mode	transmissive mode, normally white
Surface treatments	hard coating(2H), anti-glare treatment of the front polarizer

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2. 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_{DD}	-0.3	+6	Vdc	at 25 °C
Logic Input Voltage	$V_{L/H}$	V_{SS}	V_{DD}	Vdc	at 25 °C
Operating Temperature	T_{OP}	0	+50	°C	1
Storage Temperature	T_{ST}	-20	+60	°C	1

Note: 1. The Relative Humidity must not exceed 95% non-condensing at temperatures of 40 °C or less. At temperatures greater than 40 °C, the wet bulb temperature must not exceed 39 °C.

2. Under no condition should the unit be exposed to corrosive chemicals.

3. Electrical Specifications

The LCA4SE01A requires two power inputs. One is employed to power the LCD electronics and to derive the voltages to drive the TFT array and liquid crystal. The second input which powers the backlight CCFT, is typically generated by an inverter. The inverter is an external unit to the LCD.

Table 2 ELECTRICAL CHARACTERISTICS:

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
MODULE:						
Power Supply Input Voltage	V_{DD}	4.5	5.00	5.5	Vdc	
Power Supply Input Current	I_{DD}	-	200	320	mA	1
Ripple/Noise	-	-	100		mV	
Logic Input Level, High	V_{IH}	2.0	-	V_{DD}	Vdc	2
Logic Input Level, Low	V_{IL}	V_{SS}	-	0.8	Vdc	2
Power Consumption	P_C		1.0	1.6	Watts	1
BACKLIGHT						
Backlight Input voltage	V_{BL}	430	475	520	V_{RMS}	
Backlight Current	I_{BL}	3.0	4.0	5.0	mA	
Lamp Kick-Off Voltage		-	385	500	V_{RMS}	25 ± 2 °C
Operating Frequency	F_{BL}	30	45	60	KHz	
Power Consumption	P_{BL}	-	1.9	-	Watts	3

Notes: 1. The current draw and power consumption specified is for 5 Vdc at 25 °C and fv at 60Hz.

2. Logic levels are specified for V_{DD} of 5 Vdc at 25 °C. The values specified apply to all logic inputs; Hsync, Vsync, clock, data signals, etc.

3. The backlight power consumption shown above does not include loss of external inverter.

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4. Optical Specifications

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 at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0°. Appendix A presents additional information concerning the specified characteristics.

Table 2 OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	80	100	-		1
Surface Brightness, white	SB _{WH}	60	70		cd/m ²	2
Brightness Variation	SB _V		1.20	1.35	%	3
Response Time	Tr				msec	4
Rise Time	Tr _R			30		
Decay Time	Tr _D			50		
CIE Color Coordinates						
Red	x _R	0.56	0.59	0.62		
	y _R	0.30	0.33	0.36		
Green	x _G	0.29	0.32	0.35		
	y _G	0.50	0.53	0.56		
Blue	x _B	0.12	0.15	0.18		
	y _B	0.10	0.13	0.16		
White	x _W	0.29	0.32	0.35		
	y _W	0.29	0.32	0.35		
Viewing Angle					degree, °	5
x axis, right ($\Phi=0^\circ$)	θ		40			
x axis, left ($\Phi=180^\circ$)	θ		40			
y axis, up ($\Phi=90^\circ$)	θ		10			
y axis, down ($\Phi=270^\circ$)	θ		30			

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

$$\frac{\text{(Surface Brightness with all white pixels)}}{\text{(Surface Brightness with all black pixels)}}$$

2. Surface brightness is the average of 9 measurement across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Appendix A.

3. The variation in surface brightness, SB_V is determined by measuring B_{ON} at each test position 0 through 9, and then dividing the maximum B_{ON} by the minimum B_{ON}.

$$\frac{\text{Maximum (B}_{ON0}, B_{ON1}, \dots, B_{ON9})}}{\text{Minimum (B}_{ON0}, B_{ON1}, \dots, B_{ON9})}}$$

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

5. 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 Appendix A.

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5. Interface Connections

This LCD employs two interface connections, a 41 pin connector is used for the module electronics and a three pin connector is used for the integral backlight system.

The electronics interface connector is a model DF9-41P-1V, manufactured by Hirose. The mating connector part number is DF9-41S-1V or equivalent. The pin configuration for the connector is shown in the table below.

Table 3 MODULE CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description	Notes
1	GND	Ground	Connect to Vss, see Note 1
2	CLK	Main clock	
3	GND	Ground	Connect to Vss, see Note 1
4	GND	Ground	Connect to Vss, see Note 1
5	Hsync	Horizontal sync.	
6	Vsync	Vertical sync.	
7	GND	Ground	Connect to Vss, see Note 1
8	R0	Red data	Red data least significant bit(LSB)
9	R1	Red data	
10	R2	Red data	
11	R3	Red data	
12	R4	Red data	
13	R5	Red data	Red data most significant bit(MSB)
14	GND	Ground	Connect to Vss, see Note 1
15	GND	Ground	Connect to Vss, see Note 1
16	GND	Ground	Connect to Vss, see Note 1
17	G0	Green data	Green data least significant bit(LSB)
18	G1	Green data	
19	G2	Green data	
20	G3	Green data	
21	G4	Green data	
22	G5	Green data	Green data most significant bit(MSB)
23	GND	Ground	Connect to Vss, see Note 1
24	GND	Ground	Connect to Vss, see Note 1
25	GND	Ground	Connect to Vss, see Note 1
26	B0	Blue data	Blue data least significant bit(LSB)
27	B1	Blue data	
28	B2	Blue data	
29	B3	Blue data	
30	B4	Blue data	
31	B5	Blue data	Blue data most significant bit(MSB)
32	GND	Ground	Connect to Vss, see Note 1
33	GND	Ground	Connect to Vss, see Note 1
34	GND	Ground	Connect to Vss, see Note 1
35	DTMG	Data timing signal	
36	V _{DD}	Power input	+5Vdc power supply input, see Note 2
37	V _{DD}	Power input	+5Vdc power supply input, see Note 2
38	NC	No connect	
39	NC	No connect	
40	GND	Ground	Connect to Vss, see Note 1
41	GND	Ground	Connect to Vss, see Note 1

- Notes: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
2. All V_{DD}(power input) pins should be connected together.

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Interface Connections (cont'd)

The backlight interface connector is a model BHR-03VS-1, manufactured by JST. The mating connector part number is SM02(8.0)B-BHS-1-TB or equivalent. The pin configuration for the connector is shown in the table below.

Table 4 BACKLIGHT CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description	Notes
1	HV	Ground	1
2	NC	No connect	
3	LV	Lamp power input	2

- Notes:
1. The backlight ground should be common with Vss.
 2. The input power terminal is colored pink.

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6. Signal Timing Specification

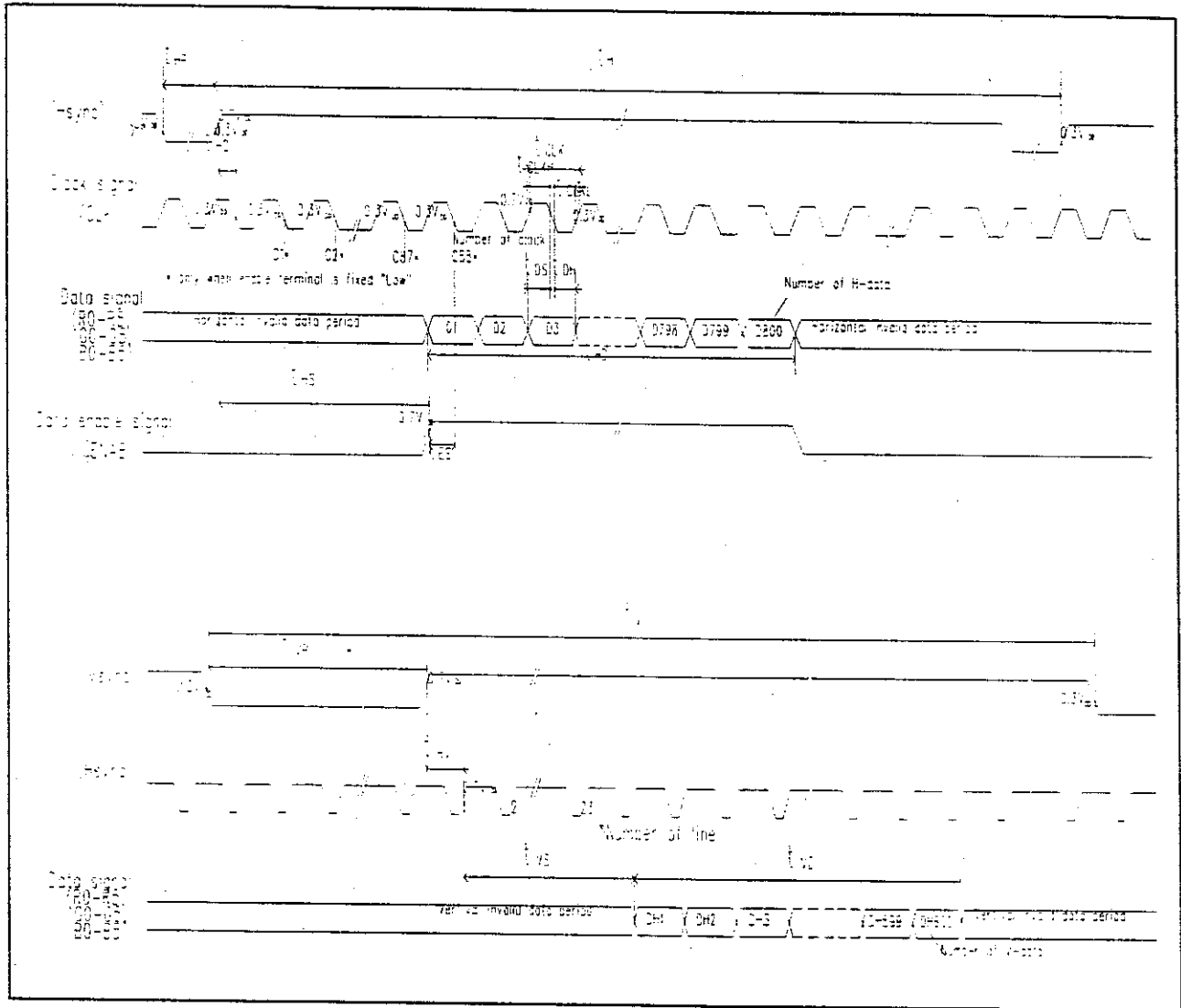
Parameter		Symbol	Value			Units	Notes
			Min.	Typ.	Max.		
Main Clock	Frequency	$f_{CLK}(=1/t_{CLK})$	-	40.0	(42.0)	MHz	1
	High duration	t_{CLKH}	5	-	-	ns	
	Low duration	t_{CLKL}	10	-	-	ns	
Data	Set-up duration	t_{DS}	5	-	-	ns	
	Hold duration	t_{DH}	10	-	-	ns	
ENAB	Set-up duration	t_{ES}	5	-	$t_{CLK}-10$	ns	2
	Pulse Width	t_{EP}	2	800	t_H-10	clock	
Hsync	Period	t_H	20.8	26.4	-	μs	
			832	1056	-	clock	
	Pulse Width	t_{HP}	2	128	200	clock	
Vsync	Period	t_V	628	666	798	lines	
			-	16.7	-	ms	
	Pulse Width	t_{VP}	2	4	6	lines	
Horizontal Display	Start	t_{HS}	88	88	88	clock	
	Period	t_{HD}	800	800	800	clock	
Vertical Display	Start	t_{VS}	23	23	23	lines	
	Period	t_{VD}	600	600	600	lines	
Hsync-Clock phase difference		t_{HC}	10	-	$t_{CLK}-10$	ns	
Hsync-ENAB phase difference		t_{HE}	58	88	170	clock	
Hsync--Vsync phase difference		t_{HV}	0	-	t_H-t_{HP}	ns	

Notes : 1. In case of lower frequency, the deterioration of display, flicker etc. may be occurred.

2. The ENAB should not be fixed 'High'

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7. Signal Timing Wave forms



Input signal waveform

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8. Color Input Data Reference

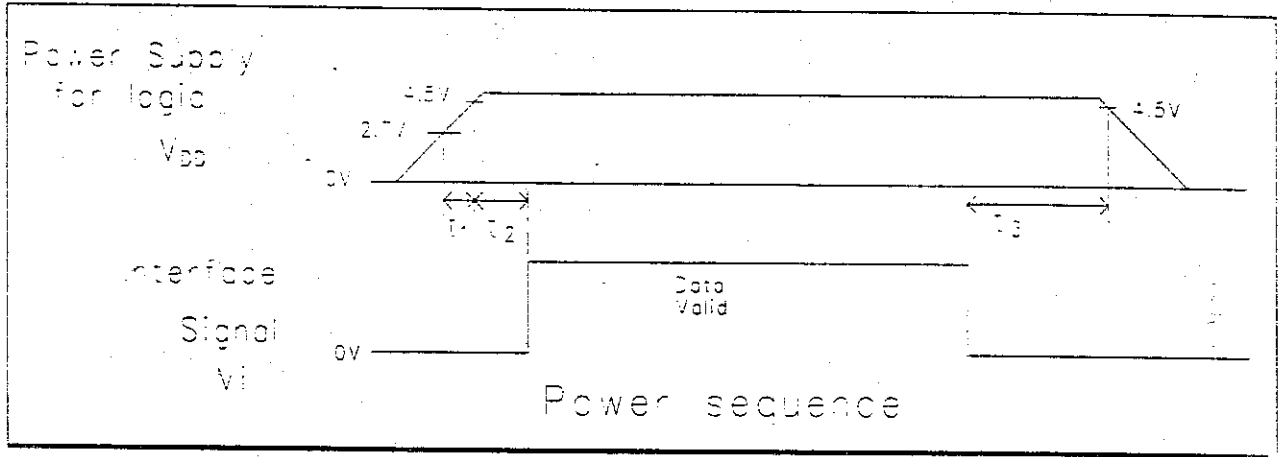
The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 5 COLOR DATA REFERENCE

Color		Input Color Data																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(00)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(00)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(00)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Red	Red(63) Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(61)	0	0	0	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
	Red(02)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(01)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(00)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(63) Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(61)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	0	0	0	0	0	0	
	Green(02)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(01)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(00)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue(63) Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(02)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(01)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(00)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

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9. Power Sequence



* Set $0 \text{ Volt} < V_i(t) < V_{DD}(t)$

Here $V_i(t)$, $V_{DD}(t)$ indicate the transitive state of V_i , V_{DD} when power supply is turned ON or OFF

- 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_{DD} to 0V.

10. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LCA4SE12A LCD. The surface of the LCD has an anti-glare coating to minimize reflection and a 2H hard coating to reduce scratching. In addition, the figure below is a detailed mechanical drawing of the LCD. Note that dimension are given for reference purposes only.

Outside dimensions:	Width	246.5 mm
	Height	179.4 mm
	Thickness	8.5 mm
Active Display area	Width	211.2 mm
	Height	158.4 mm
	Diagonal	264.0 mm
Weight (approximate)		< 400 gram

