

Product Information

ISSUE DATE : 2003-03-25
MODEL : LTM150XI-A01

Note : This Product information is subject to change after 3 months of issuing date

Prepared by AMLCD Technical Customer Service Team
Samsung Electronics Co . , LTD.

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1. General Description

LTM150XI-A01 is a new concept of System-On-Panel (SOP) display device. It provides total and high quality TFT-LCD display solutions for customer system design. Customer can use the high quality display unit just like an integrated circuit (IC).

As ICs are used as building blocks of many complicated electronic systems, this new display solution can be used just same.

This device includes the high quality TFT-LCD panel and the high brightness 4-lamp backlight unit with the optimized inverter. Integrated signal processing unit, named LSP (LCD Signal ProcessorTM), includes all electronic function for user application. It includes analog-to-digital conversion, Scaling, OSD, EDID (DDC 2 compliance) and LCD Timing controller. More functions are available, also.

World-top notebook LCD design technology of Samsung realize the most compact solution. Customer can enjoy wide system design flexibility.

EMI is the additional point of this device. All of the units are shielded by metal case finally.

* Features

- High display quality : High contrast ratio, Wide-viewing angle and High-speed response time.
- High brightness with the 4-CCFL backlight lamps using optimized inverter.
- Standard interface: Analog RGB

Interface solution is shown in next page.

- On Screen Display(OSD): Samsung generic bitmap OSD is supported, but the customized OSD is also available using system development tool.
- Digital Image Processor is embedded with intelligent microprocessor.
- Wide Input Voltage Range : +10VDC +15VDC
- DDC Ver. 2 Compliance by system integrator
- VESA DPMS compliance
- Low Power Consumption
- Easier EMI troubleshooting and solution supported.
- Easy Lamp replacement

* Information

Items	Specification	Unit	Note
Display area	304.1(H) x 228.1(V)	mm	15.0 inch diagonal
Driver element	a-Si TFT active matrix		
Display colors	16.2M (true)	colors	6-bit FRC
Number of pixels	1024 x 768	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.297(H) x 0.297(W)	mm	
Display mode	Normally White		
Surface treatment	Haze 25% , Hard-coating (3H)		
Lamp	4-Lamp		

*** Explanation for Product code**

L T M 1 5 0 X I - A01

↑ ↑ ↑ ↑ ↑

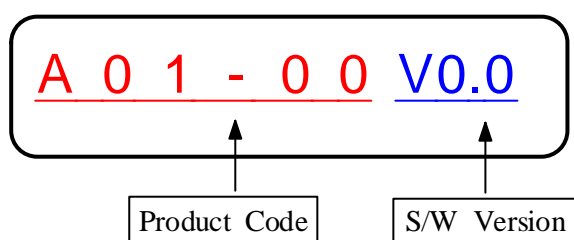
Base code Interface Derivative Customer S/W H/W

-A: Analog only Mode code revision revision

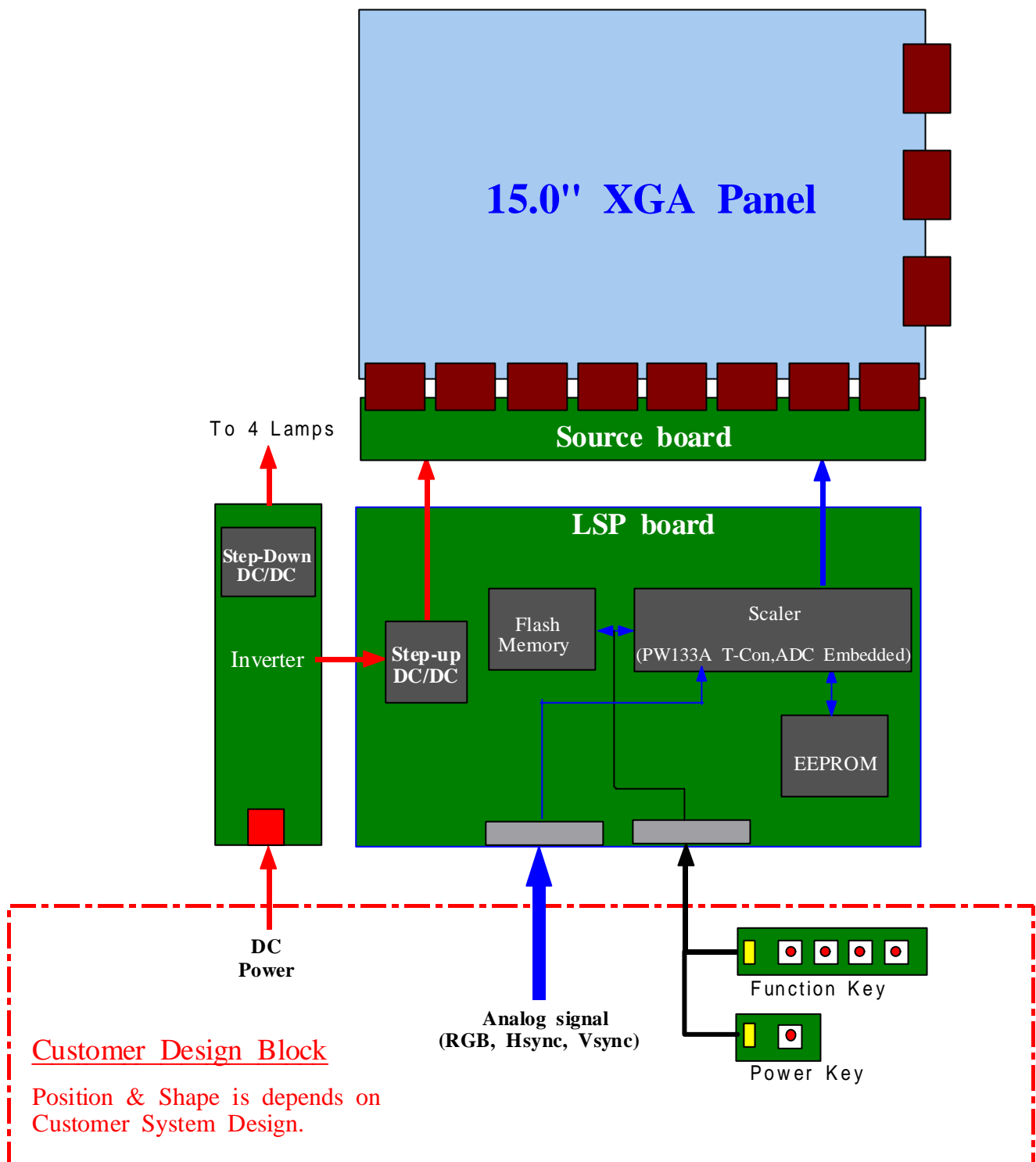
-V: Analog+Video

-D: Analog+DVI

*** LSP Board Label**



* **System Block Diagram**



* Mechanical information

Item		Min	Typ	Max	Note
Module size	Horizontal(H)	331.1	331.6	332.1	mm
	Vertical(V)	254.8	255.3	255.8	mm
	Depth(D)	-	-	18.0	mm
Weight		-	-	(1800)	g

2. Electrical Absolute Ratings

(1) TFT LCD Module

(V_{ss} = GND = 0 V)

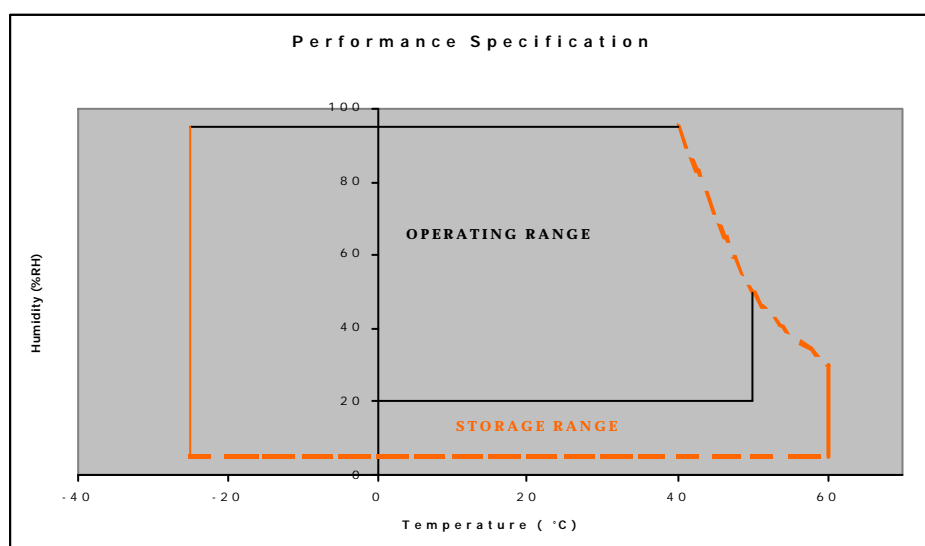
Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VDD	-0.3	+21	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

3. Environmental Specification

Items	Min.	Max.	Units	Note
Storage Temperature	-25	+60		
Operating Temperature	0	+50		
Shock (Non-operating)	-	50	G	11ms, 1 time for ±X, ±Y, ±Z
Vibration (Non-operating)	-	1.5	G	10-300Hz, Sweep rate:10min, 30min for X, Y, Z axis

Note: If this product is used for extended time excessively or exposed to high temperatures for extended time, there is a possibility of wide viewing angle film damage which could affect visual characteristics.



4. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured

in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment : TOPCON BM-5A: Contrast Ratio, Luminance of White, Viewing Angle

TOPCON BM-7: Response time, Flicker

Photo Research PR650: Color Chromaticity

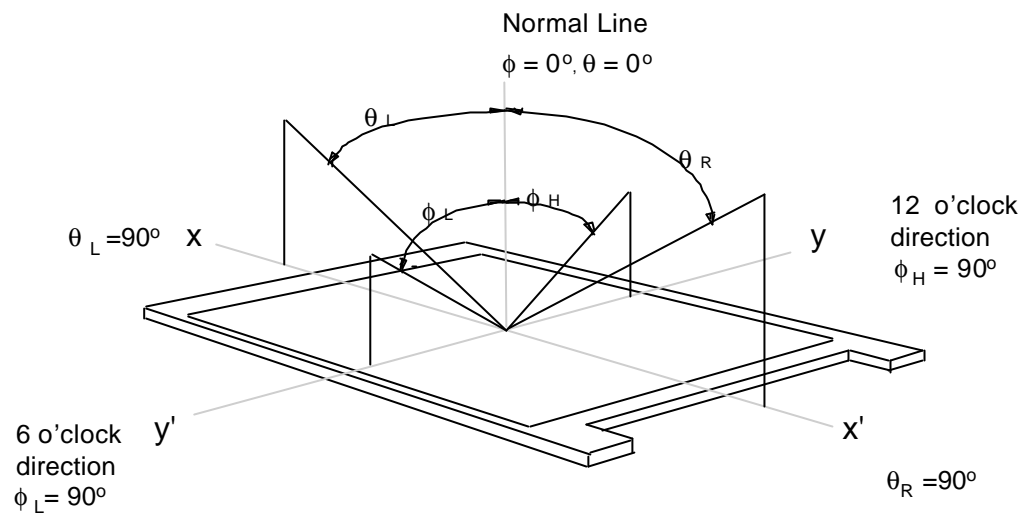
Ta = 25 ± 2 , VIN = +12V, fv= 60Hz, IL = 6.0mA

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Contrast Ratio		CR	=0, =0 Normal Viewing Angle	(200)	300	-		(1),(2),(4)
Response Time at Ta	Rising	T _R		-	5	-	msec	(1), (3)
	Falling	T _F		-	20	-		
Luminance of White (Center of Screen)		Y _L		(200)	250	-	cd/m ²	(1),(4)
Color Chromaticity (CIE 1931)	Red	R _x		(0.603)	(0.628)	(0.653)		(1), (4)
		R _y		(0.328)	(0.353)	(0.378)		
	Green	G _x		(0.265)	(0.290)	(0.315)		
		G _y		(0.570)	(0.595)	(0.620)		
	Blue	B _x		(0.119)	(0.144)	(0.169)		
		B _y		(0.063)	(0.088)	(0.113)		
	White	W _x		(0.279)	(0.304)	(0.329)		
		W _y		(0.300)	(0.325)	(0.350)		
Viewing Angle	Hor.	L	CR 10	(65)	-	-	Degrees	
		R		(65)	-	-		
	Ver.	H		(50)	-	-		
		L		(50)	-	-		
Color Gamut				-	(65)	-	%	
Brightness Uniformity (9 points)		B _{UNI}		-	-	(25)	%	(5)
Cross Modulation		C _T		-	-	(5)	%	(6)

Measuring Condition: Maximum value of Brightness and Contrast in OSD menu.

Flicker must be controlled internally. Customer specification need to exclude this item.

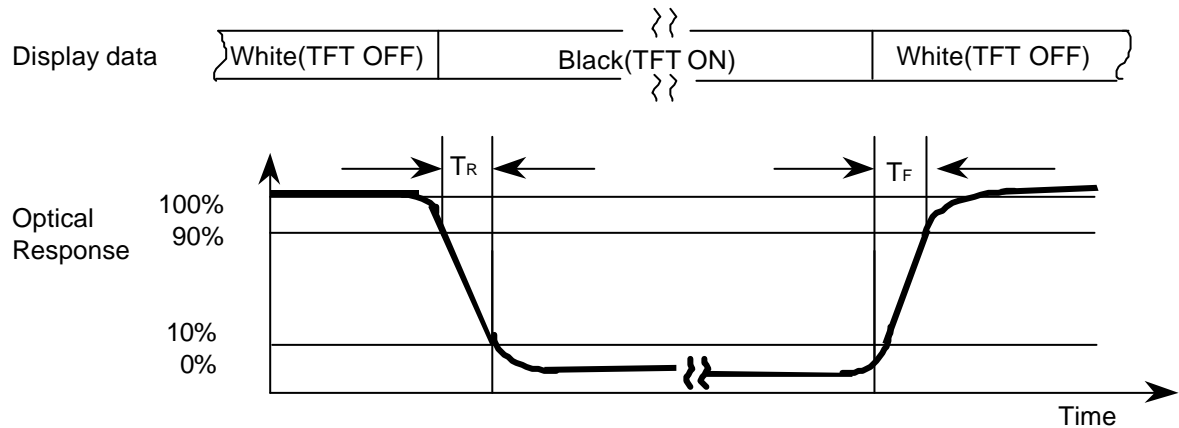
Note 1) Definition of Viewing Angle : Viewing angle range (10 £ CR)



Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at the center point of panel.

$$CR = \frac{\text{Luminance with all pixels white (Gmax)}}{\text{Luminance with all pixels black (Gmin)}}$$

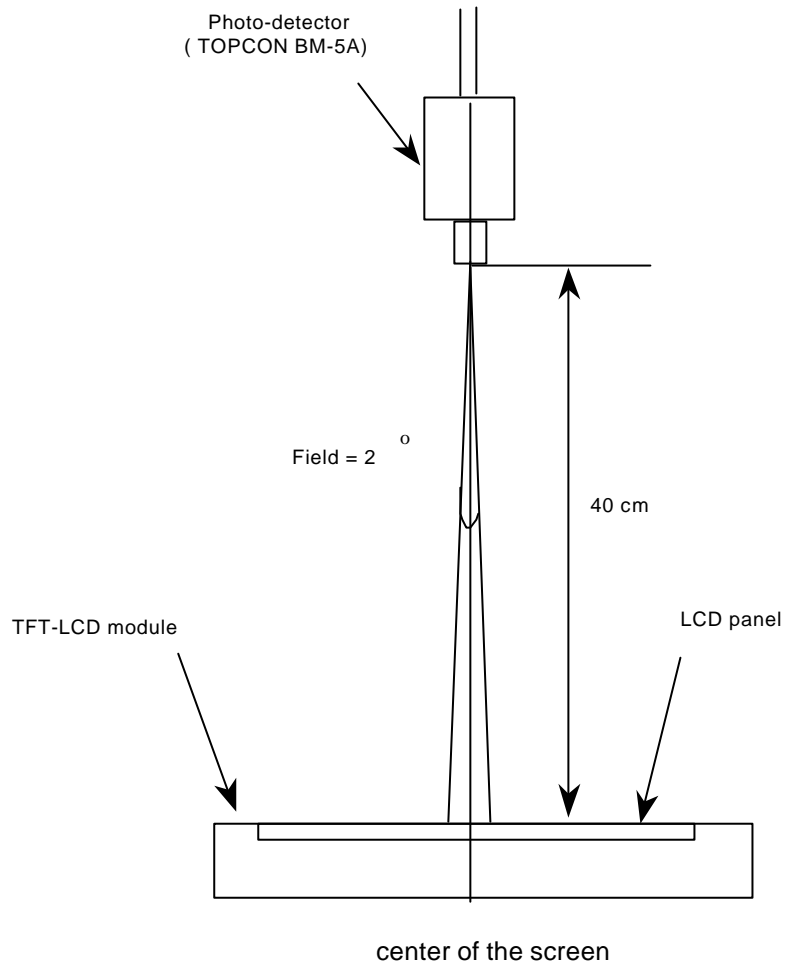
Note 3) Definition of Response time : Sum of TR ,TF



Note 4) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

Lamp current : 6.0mA

Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Optical characteristics measurement setup

Note 5) Definition of 9 points brightness uniformity

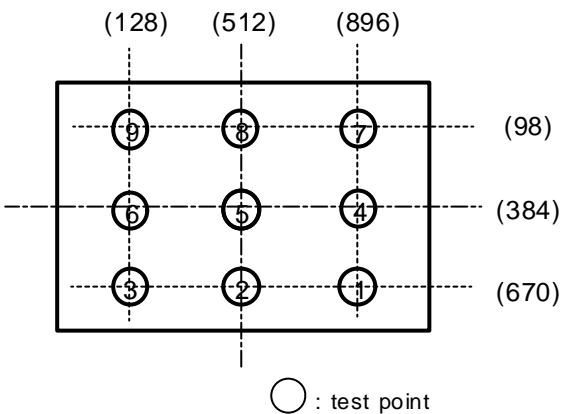
$$B_{UNI} = \frac{|B_{max \text{ or } B_{min}} - B_{ave}|}{B_{ave}} \times 100$$

Bmax : Maximum Brightness

Bmin : Minimum Brightness

$$B_{ave} : \text{Average Brightness} = \frac{\sum_{k=1}^9 B(k)}{9}$$

ACTIVE AREA



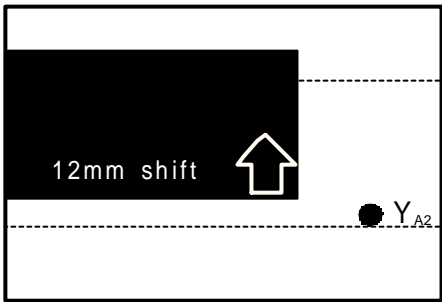
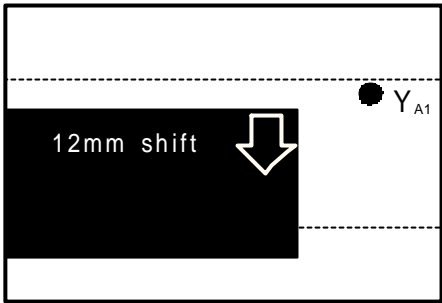
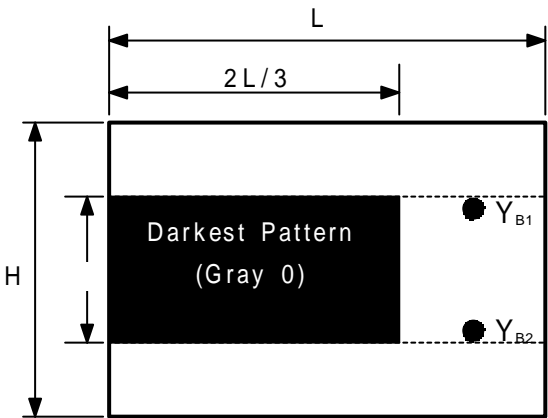
Note 6) Definition of Crosstalk (C_T)

$$\text{Crosstalk Modulation Ratio}(D_{\text{SHA}}) = \frac{|Y_A - Y_B|}{Y_A} \times 100 (\%)$$

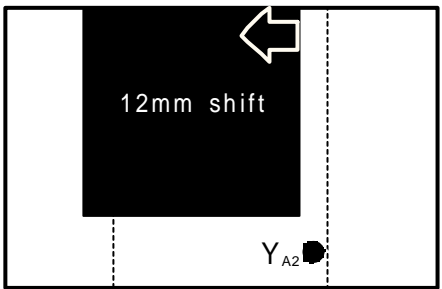
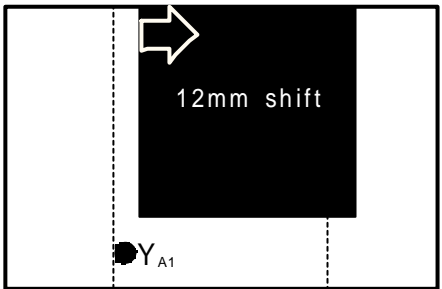
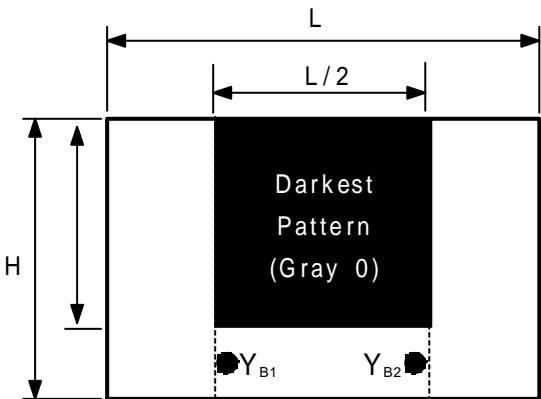
$Y_A, Y_B = 2^\circ$ Viewing Angle (Measurement Area on Panel : 12mm)

Background expect Black bar = Gray 1 63

Horizontal Crosstalk



Vertical Crosstalk



5. Electrical Specification

5.1 Input video and sync signal

* Signal Connector : S13B-PH-SM3-TB (JST)

Mating Connector : PHR-13

Item		Description	Notes
Video	Input	<ul style="list-style-type: none"> Type: Analog RGB level : 0.7Vp-p $\pm 5\%$ Polarity: Positive Bright Impedance: 75 $\pm 10\%$ (Terminated) 	VESA Compliance
	Resolution	<ul style="list-style-type: none"> Optimum: 1024 \times 768@60Hz Maximum: 1280 \times 1024@60Hz 	Down Scaling mode
	Horizontal Frequency	<ul style="list-style-type: none"> 30-61KHz (normal mode) 62-69KHz (Failure Safe mode) 	
	Vertical Frequency	<ul style="list-style-type: none"> 55-76Hz (normal mode) 77-85Hz (Failure Safe mode) 	
	Applicable Bandwidth	<ul style="list-style-type: none"> Typical: 65MHz (1024x768@60Hz) Max: 108MHz (1280x1024@60Hz) 	
	Sync Signal	<ul style="list-style-type: none"> Type: Separate H/V sync, Composite H/V sync Level: TTL level (V high 2.0V, V low 0.8V) Polarity: Positive or negative Termination resistance: more than 2K 	
Sync	Input	<ul style="list-style-type: none"> Type : separate H/V sync, Composite H/V sync Level : TTL level (V high 2.0V, V low 0.8V) Polarity : Positive or negative. 	
	Horizontal Frequency	<ul style="list-style-type: none"> 30-61KHz (normal mode) 62-69KHz (Failure Safe mode) 	
	Vertical Frequency	<ul style="list-style-type: none"> 55-76Hz (normal mode) 77-85Hz (Failure Safe mode) 	

5.2 Input Signal Pin Assignment and Description

* Analog RGB Signal Connector : S13B-PH-SM3-TB (JST)

Mating Connector : PHR-13

Items	Pin No.	Pin Name	Description	Note
Analog RGB	Pin 01	DB_DET	Cable Detect Pin	Internally Pull-Up (Connect this pin with DSUB #5 pin)
	Pin 02	DB_SDA	Serial Data for DDC	
	Pin 03	DB_SCL	Serial Clock for DDC	
	Pin 04	RGND	Red Ground	
	Pin 05	DB_RED	Red Data Input	
	Pin 06	GGND	Green Ground	
	Pin 07	DB_GRN	Green Data Input	
	Pin 08	BGND	Blue Ground	
	Pin 09	DB_BLU	Blue Data Input	
	Pin 10	NC	Not used	
	Pin 11	DB_VSY	Vsync Input	
	Pin 12	SGND	Sync Ground	
	Pin 13	DB_HSY	Hsync Input	

5.3 Function Key Pin Assignment and Description

* Connector type: 53261-1490 (MOLEX)

Mating Connector: 51021-1400(MOLEX)

Group	Pin No.	Pin Name	Description
Keypad	Pin 01	KVDD	Keypad Unit Power
	Pin 02	KGND 1	Keypad Unit Ground
	Pin 03	KEY8	Key Input #8
	Pin 04	KEY7	Key Input #7
	Pin 05	KEY6	Key Input #6
	Pin 06	KEY5	Key Input #5
	Pin 07	KEY4	Key Input #4
	Pin 08	KEY3	Key Input #3
	Pin 09	KEY2	Key Input #2
	Pin 10	KGND 2	Keypad Unit Ground
	Pin 11	KEY1	Key Input #1
	Pin 12	KGND 3	Keypad Unit Ground
	Pin 13	LED1	Status Indicator
	Pin 14	LED2	Status Indicator

5.4 Power Supply

5.4.1 Pin Assignment and description

*Connector type: 40006WR-02 (YeonHo Electronics)

Mating Connector : 40006HS-02

Pin No.	Pin Name	Description	Note
1	Vin	Input Power, +12VDC (typ.)	
2	GND	Ground	

5.4.2 Input voltage & Rush current

Items	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	Vin	+10	+12	+15	V
Rush Current	Irush	-	-	+12	A

5.4.3 DPMS: VESA DPMS compliance

5.5 Power Consumption

5.5.1 Measurement of power consumption

Normal mode (Power on)

Voltage	Current				Resolution
	Min.	Typ.	Max.	Unit	
10V	-	(2.6)	(3.0)	A	1024*768@60Hz
12V	-	(2.0)	(2.5)	A	
15V	-	(1.8)	(2.0)	A	

Power saving(Stand-by, Suspend, Off mode): less than 3 watts. Monitor has to be recovered to normal operation mode within 4 seconds when normal signal is applied from signal source.

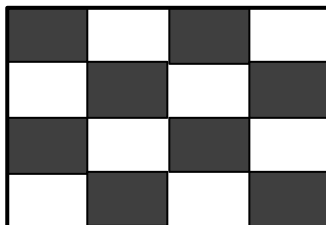
Maximum condition

- OSD condition : Brightness 100, Contrast 100
- test pattern : One pixel on/off (1dot) pattern

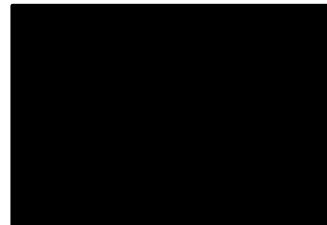
[White]



Mosaic (1 pixel on/off)]



[Black]



5.5.2 Power management mode: VESA DPMS protocol applied.

Mode	Horizontal sync	Vertical sync	LED1	LED2	Power consumption
On	Active	Active	Off	On	30 watts(Max)
Stand-by	Inactive	Active	On	On/Off (Blinking)	< 3 watts
Suspend	Active	Inactive			
Off	Inactive	Inactive			

RGB and Video inputs only.

5.6 Display Modes

No.	Mode	Resolution	Total	Horizontal		Vertical		Pixel Clock
				Frequency	Polarity	Frequency	Polarity	
1	VGA	720x400	900x449	31.47KHz	N	70.0 Hz	P	28.322MHz
2		640x350	800x449	31.47KHz	P	70.0 Hz	N	25.175MHz
3		640x480	800x525	31.47KHz	N	60.0 Hz	N	25.175MHz
4		640x480	864x525	35.00KHz	N	66.7 Hz	N	30.240MHz
6		640x480	832x520	37.86KHz	N	72.8 Hz	N	31.500MHz
6		640x480	840x500	37.50KHz	N	75.0 Hz	N	31.500MHz
7		640x480	832x509	43.27KHz	N	85.0 Hz	N	36.000MHz
8	SVGA	800x600	1024x625	35.16KHz	N/P	56.3 Hz	N/P	36.000MHz
9		800x600	1056x628	37.88KHz	P	60.3 Hz	P	40.000MHz
10		800x600	1040x666	48.08KHz	P	72.2 Hz	P	50.000MHz
11		800x600	1056x625	46.87KHz	P	75.0 Hz	P	49.500MHz
12		800x600	1048x631	53.67KHz	P	85.1 Hz	P	56.250MHz
13		832x624	1152x667	49.73KHz	N	74.6 Hz	N	57.284MHz
14	XGA	1024x768	1344x806	48.36KHz	N	60.0 Hz	N	65.000MHz
15		1024x768	1328x806	56.48KHz	N	70.1 Hz	N	75.000MHz
16		1024x768	1312x800	60.02KHz	P	75.0 Hz	P	78.750MHz
17		1024x768	1376x808	68.67KHz	P	85.0 Hz	P	94.500MHz
18	SXGA	1280x1024	1708x1056	64.00KHz	N	60.0 Hz	N	108.000MHz
7, 12, 17, 18 mode is "Fail Safe Mode"								

6. User Interface

6.1 OSD Key Matrix

This table is based on OSD S/W presented by SAMSUNG.

If our customer wants their customized OSD, Key matrix will be changed.

Input Connector		Keypad
Pin No.	Pin Name	Function
Pin 01	KVDD	+3.3V / 100mA
Pin 02	KGND1	
Pin 03	KEY8	"AUTO"
Pin 04	KEY7	"EXIT" (Source)
Pin 05	KEY6	"LEFT"(Brightness "-")
Pin 06	KEY5	
Pin 07	KEY4	
Pin 08	KEY3	"RIGHT"(Brightness "+")
Pin 09	KEY2	"MENU"
Pin 10	KGND2	
Pin 11	KEY1	"POWER"
Pin 12	KGND3	
Pin 13	LED1	LED1
Pin 14	LED2	LED2

* Firmware(including OSD) presented by SAMSUNG is edited by SDK 2.1a

* () : Hot Key

6.2 User Controls

- * Power: Turn on and off the monitor power.
- * Menu: Calls OSD menu and select the function to be adjusted.
- * Auto: Activates "Auto adjustment is being process".
- * Exit/Source
 - Exit from the OSD function or Back to previous menu.
 - Selects input signal source by press directly without OSD menu.
- * Left/Right
 - Moves the selector left and right on the OSD menu.
 - Increase or decrease the value of selected adjustment or Select proper setting.
- * LED: Indicates the status of monitor operation.
 - LED2: Normal
 - Back: Power OFF
 - LDE1: Power saving mode or Disconnection of signal cable.
- * Hot Key
 - Brightness : Adjust the brightness of back light lamp by press the Left/Right buttons without OSD menu.
 - Burn-in mode : Press "Menu" and "Exit" during 3 second
 - If you exit this function mode, press "Menu".
 - Software information check : Press "Left" and "Exit" key during 3 second.

7. Microprocessor

* Mode Detection

The microprocessor has to recognize the input signal mode automatically once input signal comes from the signal source, and then has to optimize the display adjustment accordingly integrated auto adjustment procedure.

If microprocessor finds out the input mode from NVRAM, all register sets will be initialized with this latest values, but microprocessor has to optimize all register sets with pre-set values if it does not exist on NVRAM.

* Auto Adjustment

When user activates the auto adjustment function by pressing AUTO button, the microprocessor will optimize all display adjustment sets such as video offset, gain, position, phase, and frequency automatically according to pre-programmed auto adjustment program.

* Manual Adjustment

If the microprocessor does not optimize all adjustments successfully, the manual adjustment will allow the correction of image adjustment along with OSD functionality. This adjustment has to be described in the user manual correctly.

* Saving Adjustment

The microprocessor manages to save all adjustment results automatically into external NVRAM when adjustment is finished.

* Out of Range

The microprocessor has to manage all input signals to figure out the data identification. If the input signal is out of permitted frequency, the microprocessor has to protect all circuitry to avoid any electrical problem, and then has to display the warning message according to pre-programmed message like "Please re-configure the display timing of your system". But, it will not allow to enter DPMS mode.

This system will judge the input signal as follow the below;

Horizontal frequency: <30KHz, >69KHz

Vertical frequency : <55Hz, >85Hz

* Display Mode (Normal and Fail-Safe mode)

If the input signal is in the permitted frequency range as below, it will be operated in normal mode.

Normal mode

Horizontal frequency : 30-61KHz

Vertical frequency : 55-76Hz

But, if the input signal is higher than normal input frequency, it will be converted into FailSafe mode with gray converted image to allow reconfiguration of monitor setting using Windows control panel menu. This functionality will minimize the installation failure by end-user.

FailSafe mode

> Horizontal frequency : 62-69KHz

> Vertical frequency: 77-85Hz

*** Brightness Adjustment**

The system has two kinds of brightness adjustment modes as below;

Normal operation: The brightness of backlight has to be adjusted by pressing designated key.

*** Power Management**

This system's power management protocol follows VESA DPMS compliance in section of 2.5.3 "Power management", but it has to be managed along with the below horizontal and vertical frequency guide line to identify the sync signal status.

Stand-by mode: Horizontal frequency < 10KHz, Vertical frequency > 40Hz, maintain more than 3 seconds.

Suspend mode: Horizontal frequency > 10KHz, Vertical frequency < 40Hz, maintain more than 3 seconds.

Power-off mode: Horizontal frequency < 10KHz, vertical frequency < 40Hz, maintain more than 3 seconds.

*** Factory Reset**

One designated key allows to reset all data sets into factory preset values. But, it is not allowed to get the previous user set status after this function is finished.

The system has to have this factory preset values prior to shipment to our customer.

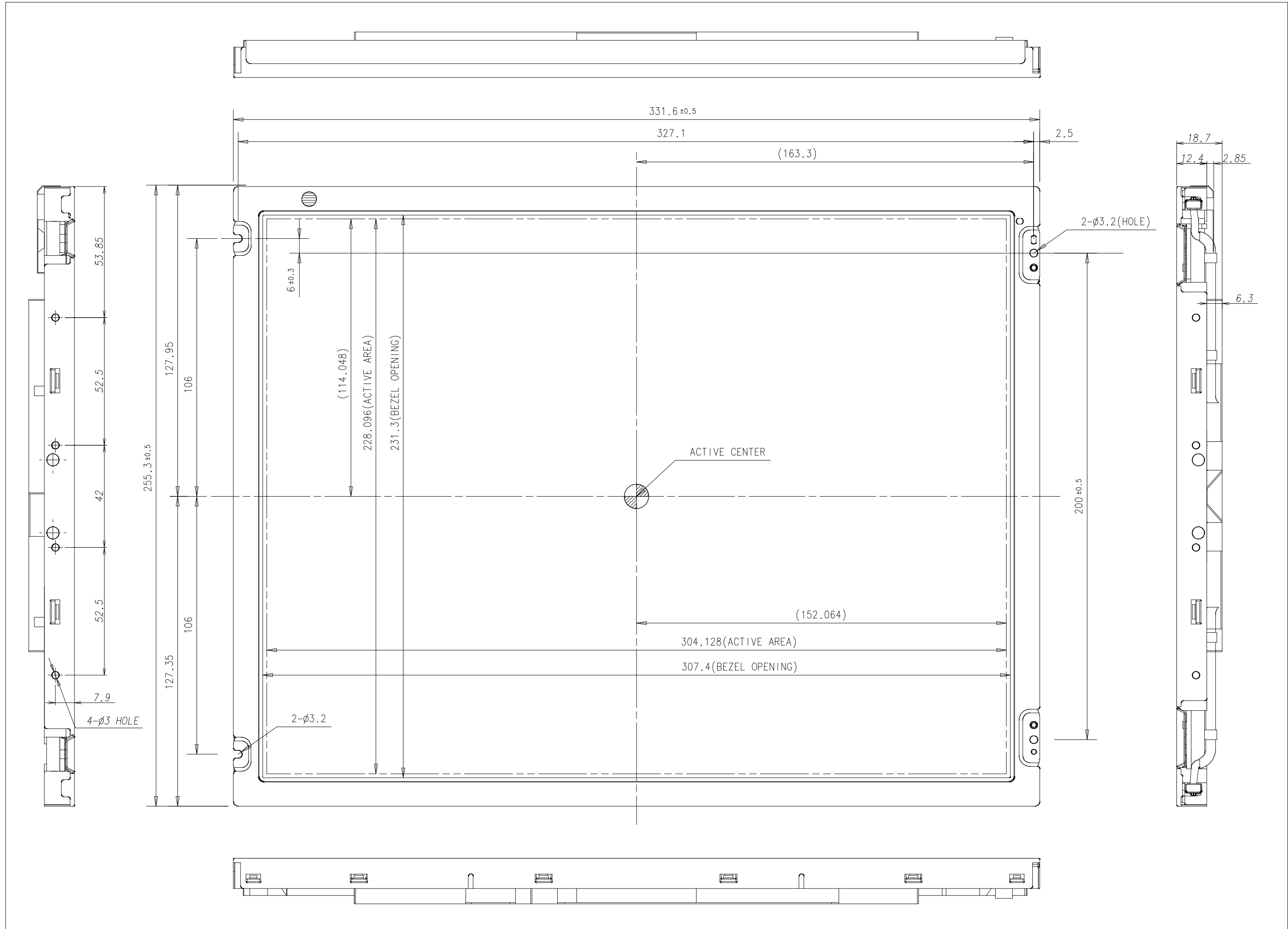
*** DDC (EDID)**

This system has one dedicated DDC ROM on the circuitry board. The final monitor system company can installed the EDID data as refer to attachment 2 "EDID Specification" into this ROM through the serial port of VGA connector.

8. Mechanical Specification

8.1 Outline dimension

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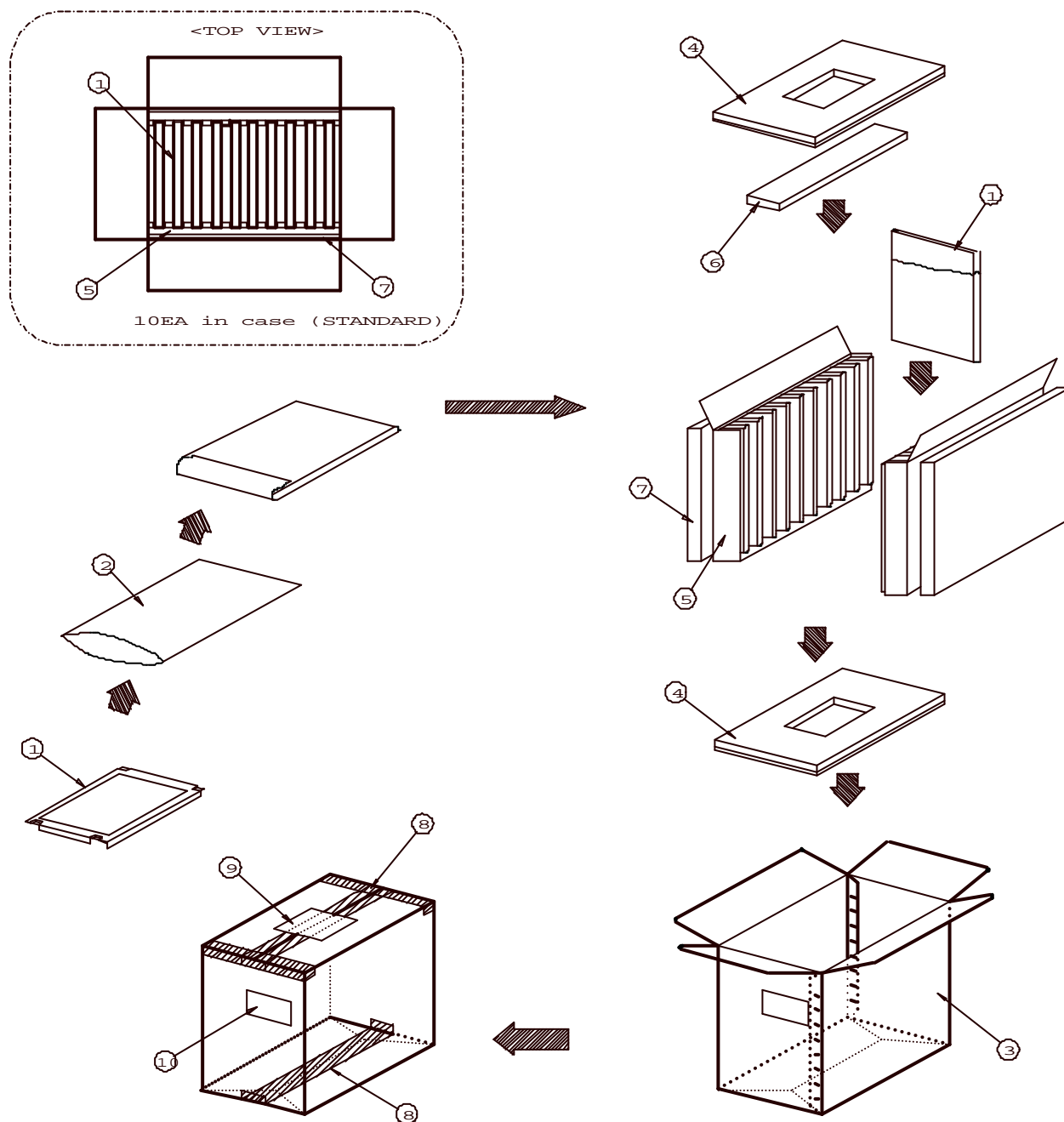


8.2 Packing Information

8.2.1 Carton (Internal Package)

8.2.1.1 Packing Form: Corrugated fiberboard box and corrugated cardboard as shock absorber.

8.2.1.2 Packing Method



NOTE 1) Acceptance number of piling : 10sets
2) Carton size :450(W) X 348(D) X 440(H)
3) MAX accumulation quantity : 4 cartons

8.2.1.3 Unless LCD Module are 10ea at one packing_case

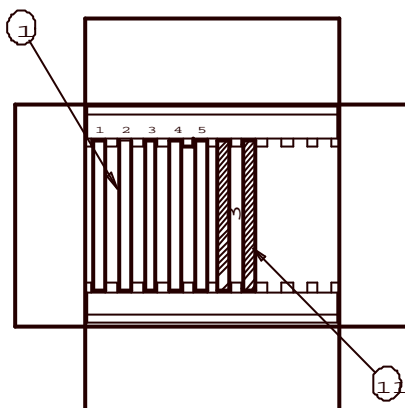
○

* Unless LCD module are 10EA
at one packing-case.

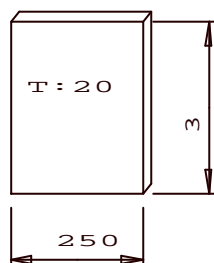
--> 1) Put in some LCD module
in the direction of one.

2) Try addition PAD CUSHION(2EA)
in the next position.

ex) LCD module are 5EA in case.



* PAD CUSHION size
(LT140X1/LTM150XS MODEL)
: 250(W) × 330(H) × 20(T)



8.2.1.4 Packing Material

No	Part name	Quality
1	Static electric protective sack	10
2	Packing case(Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

9. GENERAL PRECAUTION

9.1 Handling

When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.

Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth. The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

Protect the module from static, it may cause damage to the CMOS Gate Array IC.

Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

Do not disassemble the module.

Do not pull or fold the lamp wire.

Do not adjust the variable resistor which is located on the back side.

Pins of I/F connector shall not be touched directly with bare hands.

9.2 Storage

Do not leave the module in high temperature, and high humidity for a long time.

It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%.

Do not store the TFT-LCD module in direct sunlight.

The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

9.3 Operation

Do not connect,disconnect the module in the Power On condition.

Power supply should always be turned on/off by the item 6.5 ? Power on/off sequence?

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 minimize the interference.

The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly. The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

9.4 Others

Ultra-violet ray filter is necessary for outdoor operation.

Avoid condensation of water. It may result in improper operation or disconnection of electrode.

Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

If the module displays the same pattern continuously for a long period of time, it can be the situation when the image Sticks to the screen.

This module has its circuitry PCB on the rear side and should be handled carefully in order not to be stressed.