

Customer Specification

HL1936SMT-L/R

19 Inch LCD Display

Name	Department/Title	Date	Signature

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1. SCOPE

This document defines the performance requirements for a 19.0-inch TFT LCD monochrome monitor for medical use. This product is controlled by model name; any change will be recorded in the list and confirmed by GE.

This high-resolution monochrome display is specifically designed to meet the rigorous performance standards needed for diagnostic, interventional radiology, and other medical applications. To guarantee image integrity, features include accurate signal conversion and a wide range of interfacing options.

This monitor is factory calibrated to achieve DICOM part 3.14 compliance and Gamma CIE at the factory set point. The luminance stabilization circuit employs a built in photo sensor to keep the back-light lamps at a constant luminance for consistent calibration over the life of the display and can control the back light system automatically to extend the life of the monitor and achieve very short warming up time.

The surface of the monitor has an anti-glare coating to minimize reflection and a hard coating to reduce scratch.

With the deliberate designed bracket the monitor can stick on the desktop firmly.

The monitor has a glass on the LCD.(HL1936SMT-L)

The monitor has a touch screen on the LCD. (HL1936SMT-R)

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2. ELECTRICAL PERFORMANCE

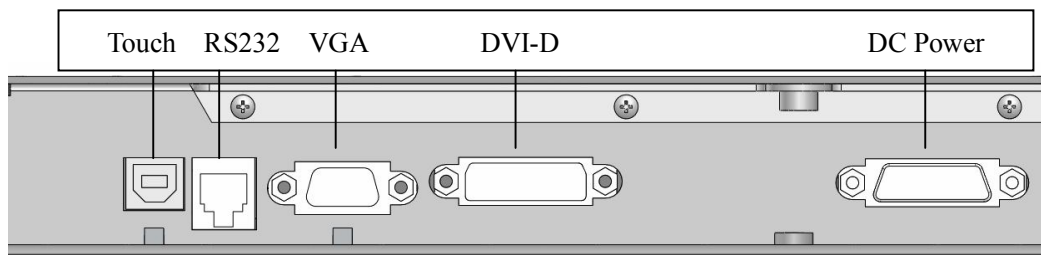
2.1 Power Supply

-Input Voltage	: DC24V \pm 10%
- Current (max)	: 2A
- Power Consumption	: <50W

2.2 Power Management

Power Management condition and status for ANALOG Input mode						
State	SIGNALS			Power	LED	
	Horizontal	Vertical	Video	Consumption	Status	
ON	ON	ON	Active	<50W	Green	
Active off	OFF	ON	Blanked	<5W	Orange Blinking	
	ON	OFF	Blanked			
	OFF	OFF	Blanked			
Power Management condition and status for DIGITAL Input mode						
State	SIGNALS				Power	LED
	DE	Horizontal	Vertical	Video	Consumption	Status
ON	Pulses	ON	ON	Active	<50W	Green
Active off	NO Pulses	N/A	N/A	Blanked	<5W	Orange Blinking

2.3 Signal Interface



2.3.1 Signal Specifications

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Item		SPEC
Analog Signal Input	Frequency	Analog: H 30 ~ 82kHz V 50 ~ 85Hz
	Pixel clock	25--165MHz
	Video Input VGA	Analog 0.7Vpp Input Impedance 75 Ohm
	Sync Signal	Separate Sync, TTL (N or P),SOG
	CVS Signal Input	Video Level: 0.5---1.0V Sync level: 0.2---0.3V
Digital Signal Input	DVI Digital Input	DVI-Digital DDC via DVI

2.3.2 VGA Connector and Pin Assignment

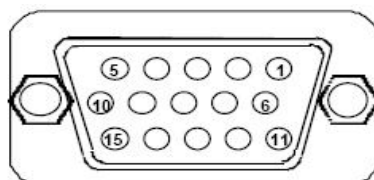


Figure 1

15-pin Mini D-type Female Connector

Pin - Assignment of 15-pin D-sub:					
1	Red Video	6	Red Ground	11	Monitor Ground
2	Green Video	7	Green Ground	12	DDC-Serial Data
3	Blue Video	8	Blue Ground	13	H-Sync.
4	N/C	9	NC	14	V-Sync.
5	GND	10	Logic Ground	15	DDC-Serial Clock

2.3.3 Digital Visual Interface and Pin Assignment (DVI-D)

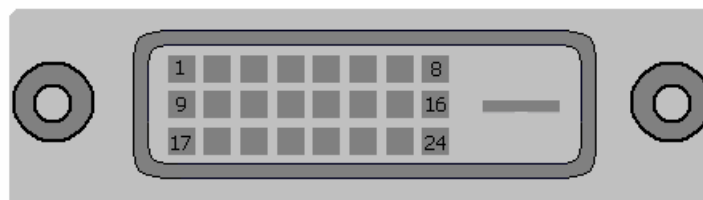


Figure 2

25-pin DVI-D Female Connector

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Only support DVI single link , pin 4,5,12,13,20,21 do not work.

Pin - Assignment of 25-pin DVI-D Female Connector		
Pin 1 - TMDS Data 2-	Pin 12 - TMDS Data 3-	Pin 22 - TMDS Clock Shield
Pin 2 - TMDS Data 2+	Pin 13 - TMDS Data 3+	Pin 23 - TMDS Clock+
Pin 3 - TMDS Data 2/4 Shield	Pin 14 - +5 V Power	Pin 24 - TMDS Clock-
Pin 4 - TMDS Data 4-	Pin 15 - Ground	
Pin 5 - TMDS Data 4+	Pin 16 - Hot Plug Detect	
Pin 6 - DDC Clock	Pin 17 - TMDS Data 0-	
Pin 7 - DDC Data	Pin 18 - TMDS Data 0+	
Pin 8 - Analog Vertical Sync	Pin 19 - TMDS Data 0/5 Shield	
Pin 9 - TMDS Data 1-	Pin 20 - TMDS Data 5-	
Pin 10 - TMDS Data 1+	Pin 21 - TMDS Data 5+	
Pin 11 - TMDS Data 1/3 Shield		

2.3.4 Control Interface

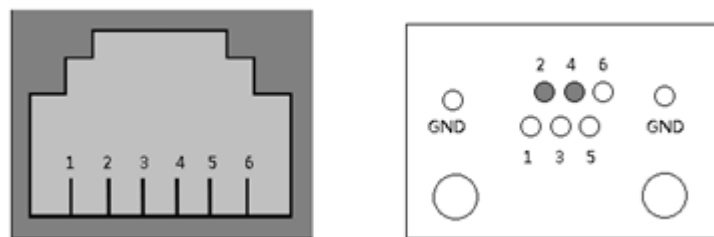


Figure 3

6-pin RJ11 Connector

Pin	Signal	Pin	Signal
1	NC	4	Transmitted Data
2	Received Data	5	NC
3	GND	6	NC

Software update of the display and automatic calibration with external luminance spot meter will be through this port.

2.3.5 USB Interface (HL1936SMT-R)

The monitor supports touch function ,the touch screen can be used in the Windows and the Linux.

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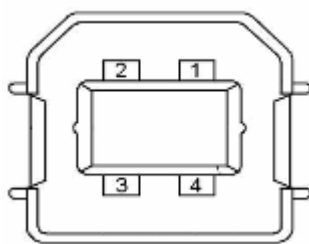


Figure 4

USB-B connector

Pin	Signal
1	VBUS
2	D-
3	D+
4	GND

2.4 Product Features

Item		Specification	
		Analog Input	Digital Input
LCD	Panel Module	INNOLUX R190EFE-L53	
	Size	19.0" (48 cm diagonal)	
	Active Display Area	376.32 (H) x 301.056 (V) mm	
	Resolution	1280 x 1024 dots (SXGA)	
	Pixel Pitch	0.294(H) x 0.294(V) mm	
	Luminance	1400cd/m2 (typical); 1200cd/m2 (min.)	
	Viewing Angle (Type.) CR>10	H	L 85 degree
			R 85 degree
		V	H 85 degree
			L 85 degree
	Contrast Ratio	1000:1 (typical); 800:1 (min.)	
	Backlight	Edge LED	

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Input Signals	Horizontal frequency	31Hz –82kHz	31kHz -82kHz
	Vertical frequency	50.0Hz - 85Hz (Non-Interlaced)	50.0Hz -85 Hz (Non-Interlaced)
	Video Signal	Analog RGB	Digital RGB
	Sync. Signal	Separate Sync. (TTL) Composite Sync. Sync on green	TMDS
	Pixel Clock	25.0MHz -165.0MHz	25.0MHz -165.0MHz
	Input connector	Mini D-sub 15Pin	DVI-D
Control key	Menu, up, down, exit		
Functions	OSD	Backlight, Contrast, Brightness level, Position, Size, Phase, Gamma, DICOM etc.	
Regulations	Safety	IEC60601-1, CCC	
	EMC	IEC60601-1-2	
	Power Management	VESA DPMS, EPA,	
	Plug and Play	VESA DDC2B	
	Temperature	10-40 °C	
Environment Condition	Humidity	10% -80% (non-condensing)	
	Input Voltage	DC24V; <2A	
Power Supply	Power Consumption	Normal operation <50W	
	Power saving	<5W	
	Input Connector	3W3 FEMALE R/A Type	
VESA compatible arm mounting interface		100mm x 100mm	

- Remark: The monitor shall recognize preset modes within a range of $\pm 1\text{kHz}$ for horizontal and $\pm 1\text{Hz}$ for vertical. (See appendix 1)

2.5 Screen Performance

2.5.1 Standard Testing Conditions

- Warm up time	≥ 20 minutes.
- DC supply voltage	+24V DC
- Ambient temperature	20°C -28°C
- Relative Humidity	30%-80%
- Video signal	1280 x 1024 @ 60Hz; DVI-D
- Ambient Environment	Dark
- Setting	Set to Gamma 2.2 factory preset
- Luminance meter	Minolta CA-310 or equivalent

2.5.2 Brightness

2.5.2.1 Factory Settings

- ◆ Factory Preset (Gamma2.2 default,Gamma1.8,Gamma2.0) :

SETTING1: $L_{min} < 1 \text{cd/m}^2$

$L_{max} = 500 \pm 20 \text{cd/m}^2$

SETTING2: $L_{min} < 1 \text{cd/m}^2$

$L_{max} = 600 \pm 20 \text{cd/m}^2$

SETTING3: $L_{min} < 1.2 \text{cd/m}^2$

$L_{max} = 700 \pm 20 \text{cd/m}^2$

- ◆ Factory Preset (DICOM) : SETTING1: $L_{min} < 1 \text{cd/m}^2$

$L_{max} = 500 \pm 20 \text{cd/m}^2$

SETTING2: $L_{min} < 1 \text{cd/m}^2$

$L_{max} = 600 \pm 20 \text{cd/m}^2$

SETTING3: $L_{min} = < 1.2 \text{cd/m}^2$

$L_{max} = 700 \pm 20 \text{cd/m}^2$

- ◆ Factory Preset (CIE) : SETTING1: $L_{min} < 1.5 \text{cd/m}^2$

$L_{max} = 500 \pm 20 \text{cd/m}^2$

SETTING2: $L_{min} < 1.8 \text{cd/m}^2$

$L_{max} = 600 \pm 20 \text{cd/m}^2$

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SETTING3: $L_{min} < 2 \text{cd/m}^2$

$L_{max} = 700 \pm 20 \text{cd/m}^2$

Max. Brightness: $\geq 800 \text{cd/m}^2$ (adjust Backlight, Contrast and Brightness to Maximum)

◆ Test Condition: White Luminance (L_{max}) is defined as a luminance of L255 Gray

Level at the center point on LCD surface. Also Black Luminance (L_{min}) is defined as a Luminance of L0 Gray level at the center point on LCD surface. (See Note 1 Note 4)

2.5.2.2 Gamma Curve Description

$$L_i = L_0 + (i/255)^{\text{gamma}} (L_{255} - L_0)$$

L_i is the desired luminance of graylevel i . L_0 is the luminance of graylevel 0.

L_{255} is the luminance of graylevel 255.

2.5.2.3 Dicom Formulas

$$j(L) = A + B \cdot \log_{10}(L) + C \cdot (\log_{10}(L))^2 + D \cdot (\log_{10}(L))^3 + E \cdot (\log_{10}(L))^4 + F \cdot (\log_{10}(L))^5 + G \cdot (\log_{10}(L))^6 + H \cdot (\log_{10}(L))^7 + I \cdot (\log_{10}(L))^8$$

where \log_{10} represents logarithm to the base 10, and $A = 71.498068$, $B = 94.593053$, $C = 41.912053$, $D = 9.8247004$, $E = 0.28175407$, $F = -1.1878455$, $G = -0.18014349$, $H = 0.14710899$, $I = -0.017046845$.

$$\log_{10} L(j) = \frac{a + c \cdot \ln(j) + e \cdot (\ln(j))^2 + g \cdot (\ln(j))^3 + m \cdot (\ln(j))^4}{1 + b \cdot \ln(j) + d \cdot (\ln(j))^2 + f \cdot (\ln(j))^3 + h \cdot (\ln(j))^4 + k \cdot (\ln(j))^5}$$

with \ln referring to the natural logarithm, j the index (1 to 1023) of the Luminance levels L_j of the JNDs, and $a = -1.3011877$, $b = -2.5840191\text{E-}2$, $c = 8.0242636\text{E-}2$, $d = -1.0320229\text{E-}1$, $e = 1.3646699\text{E-}1$, $f = 2.8745620\text{E-}2$, $g = -2.5468404\text{E-}2$, $h = -3.1978977\text{E-}3$, $k = 1.2992634\text{E-}4$, $m = 1.3635334\text{E-}3$.

$$J_i = J_0 + (J_{255} - J_0)/255; \quad L_i = 10^{L(J_i)}$$

J_i is graylevel is JNDs. L_i is the desired luminance of graylevel i .

2.5.2.4 CIE Formula

$$L_i = ((100 \cdot i/255 + 16)/116)^3 \cdot L_{255},$$

L_i is the desired luminance of graylevel i . L_{255} is the luminance of graylevel 255.

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2.5.3 View angle

Left/Right and Up/Down typical 170 degree (CR \geq 10) (Note 2)

2.5.4 Brightness Uniformity

Deviation less than 30% (Note 5)

2.5.5 Contrast ratio

The panel's native contrast ratio should be at least 800:1. (Note 3)

2.5.6 Response Time

Typical ($T_{on} + T_{off}$): 30ms (Note 6)

2.5.7 Gamma Curve

Within $\pm 10\%$ tolerance of calculated value

Factory Preset gamma value: CIE;DICOM; Gamma1.8, Gamma2.0, Gamma2.2

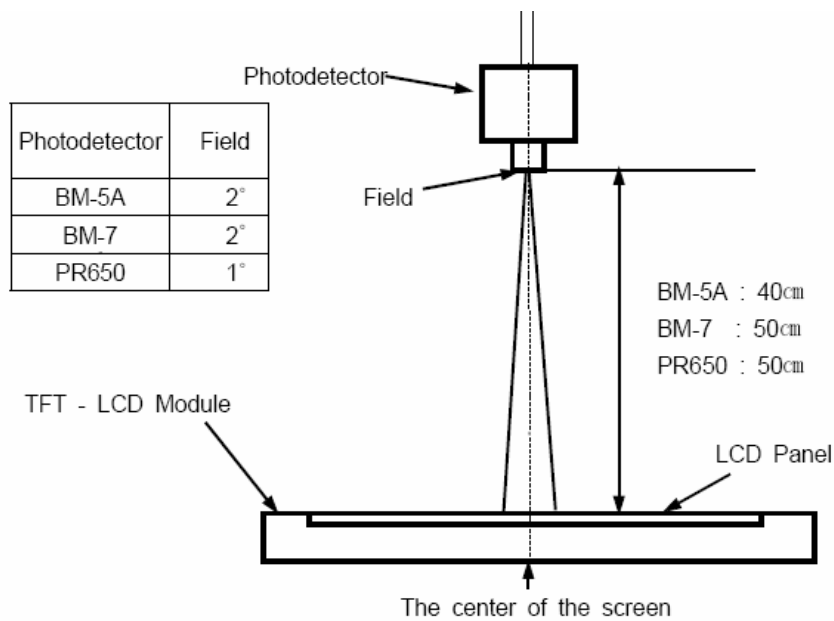
(Gamma2.2 is default setting)

Note1: Test Equipment Setups

The measurement should be executed in a stable, windless and dark room between 20 minutes after the backlight at the given temperature for stabilization of the backlight. This should be measured in the center of screen. Test equipment should be equivalent with the following equipment.

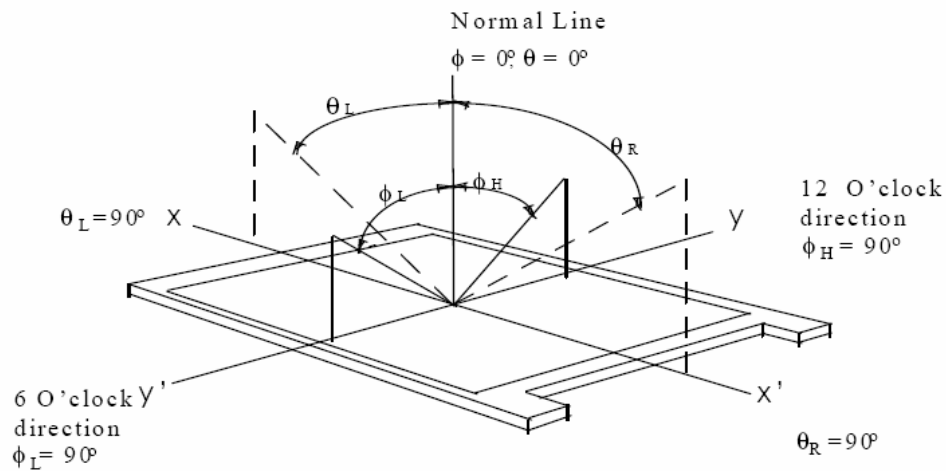
Environment condition: $T_a = 25 \pm 2^\circ\text{C}$

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Optical Measuring Equipment Setup

Note2: Viewing angle is measured as follow:



Note 3: Definition of contrast Ratio (CR):

Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel.

$$CR = \frac{G_{\max}}{G_{\min}}$$

Gmax: Luminance with all pixels white

Gmin: Luminance with all pixels black

Note 4: Definition of Luminance of White: Luminance of white at center point.

Note 5: Definition of brightness uniformity

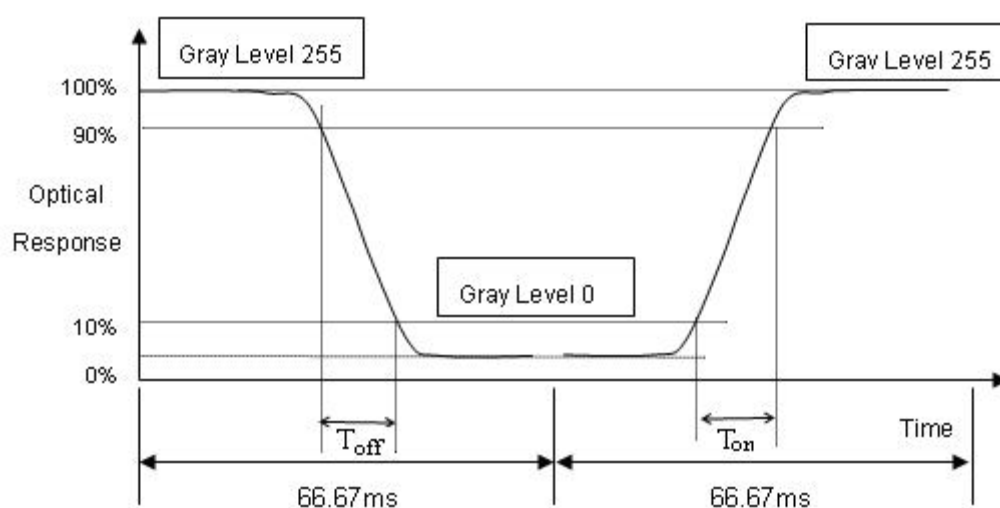
$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax: Maximum brightness

Bmin: minimum brightness

Note 6: Definition of response time is as follows:

Definition of Response Time (T_{on} , T_{off}):



3. OPERATING GUIDE

3.1 Keys assignment

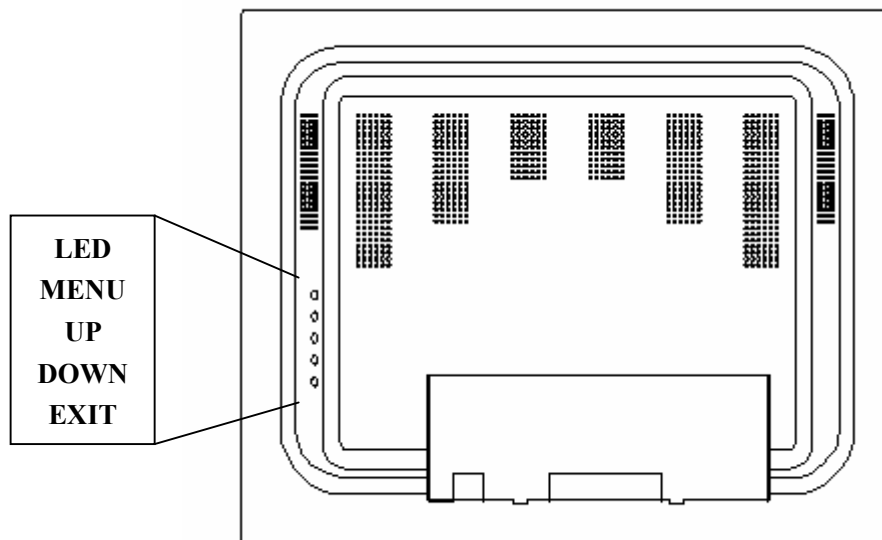


Figure3

3.2 Key Functions without active OSD Menu

Key	Action
Menu	Activate OSD
Down	Analog Input auto balance

Note: This choice is in case all the signal sources are available. If not, the signal on the any one input will be displayed.

3.3 Key Functions in the OSD Menu

Keys	Situation	Action
Menu	Always	Jump to next line
Up	Slide controller	Increase Value
	Command	“Enter Key”
Down	Slide controller	Decrease value

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EXIT	Except “Exit OSD” Menu	One menu level upwards (Settings are retained)
	In “Exit OSD” Menu	Return to main menu (Settings are retained)

3.4 Submenu Calls

Press the “Menu” key while the OSD is active, the function icon will jump to next line. Pressing the “Up” key, the coordinate submenu will be selected.

3.5 Locking of OSD Menu

Keys	Action
1 time EXIT key 3 times Up key within 3 seconds	Lock or unlock OSD If the OSD is locked, it is only possible to select input source (see 3.1 section).

3.6 Description of OSD Menu

Main Menu	Function	Adjustment range	Description
Performance	Brightness	0...255	Set brightness. Adapting the image quality of darker picture areas. The center point is in 128 position. Note: The brightness settings are already optimized for digital signals. Manual changes to these values are not recommended, as this can result in an impairment of picture quality (loss of grayscales).
	Contrast	0...255	Adjustment of contrast. This allows the brighter area to be seen more distinctly. The center point is in 128 position. Note: for DVI-D signal the Contrast setting is optimized. Manual changes are not recommended.
	Backlight	0...255	It is used to adjust the Brightness

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			of the monitor.
	Color	Setting1 Setting 2 Setting 3 User	Set desired Brightness level: Three fixed Brightness level are available The default value is: Setting1: 500cd/m2; Setting2: 600cd/m2; Setting3: 700 cd/m2 While choose setting 1,2,3 state it will recall factory default Black level, Contrast, Backlight
Display Settings	H Position (Analog only)	0...255	Shift picture in horizontal direction
	V Position (Analog only)	0...255	Shift picture in vertical direction
	Frequency (Analog only)	0...100	Adjust the frequency and phase of the input signal.
	Hsync Phase (Analog only)	0...63	Source clock phase
	Sharpness	Interpolation filter -5 to 5	One of the 11 filters can be selected for the sharpness setting to reduce scaling artifacts. Interpolation filters depend on the input resolution. Digital signals which is used with 1280X1024 resolution can not be adjusted since each pixel is controlled by its own pulse. Other digital signals which is lower than 1280 x 1024 can be adjusted. Analog signals can be adjusted in all supported resolution. Negative figure is adjusted to get softer image and positive figure is adjusted to get sharper image. The user should individually adjust the filter depending on the application.
Input Source		DVI-D VGA	Select the active input source priority. If you call this OSD menu, the current source is displayed. If current source is inactive (NO sync) and, it will auto search other port.

Auto Adjust (Analog only)	Auto-Color	ON / OFF	Automatically get input signal match with the monitor
	Auto-Config	ON / OFF	Automatically adjust the image display settings.
	Execute		The selected auto functions are executed. Note: The quality of the function depends on the applied picture contents. To get better effect it is recommended to apply full screen picture and including white and dark contents.
OSD Settings	H position	0 ... 255	Adjustment of OSD horizontal position
	V position	0 ... 255	Adjustment of OSD vertical position
	Background	0 ... 12	Select the OSD background transparency
	LED	ON/OFF	Setting the status of the operation LED.
	Language	English	Use the "Language" menu to select the language of the OSD menu. English is the default. While in the English menu state the "中文" font means to select to Chinese menu. And while in Chinese menu state the "English" font means to select to English.
		中文	
Information	Firmware Version OSD Version Config Version Power Saving Input Source LUT Working Hours		Current display status can be informed.
Service Level 2	Settings in this menu must only be carried out by service person*		

Exit	Reject changes Accept changes Quit OSD	Check reject changes or accept changes when quit OSD menu.
------	--	--

* Service level 2 enter: while the highlight line is on the service level 2 position, press 1 x Up, and 2 x Down keys, it will enter the following submenu.

Service level2	LUT select and factory settings recall: Contrast; Brightness; Backlight; Setting1; OSD position; corresponding LUT factory recall. (The default state is Gamma2.2LUT)	
	CIE	Select Gamma CIE LUT
	DICOM	Select DICOM LUT
	Gamma 1.8	Select Gamma 1.8 LUT
	Gamma 2.0	Select Gamma 2.0LUT
	Gamma 2.2	Select Gamma 2.2 LUT(default)

3.7 Factory Default Setting

Main Menu	Function	Default Value
Performance	Brightness	128
	Contrast	128
	Color	Setting1
Display Settings	Sharpness	2
Auto Adjust (Analog only)	Auto-Color	ON
	Auto-Configure	ON
OSD Settings	Horizontal position	255
	Vertical position	255
	Background	2
	LED	ON
	Language	English

Service level 2:

Service Level2	LUT Settings	Gamma 2.2
	Advanced Functions	ALC OFF
		Hotkey: ON
		DICOM Backlight: OFF
		Backlight EOL: OFF
		Power saving: OFF

Others:

OSD Menu status: locked

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4. MECHANICAL SPECIFICATIONS

4.1 Outline dimensions & weight

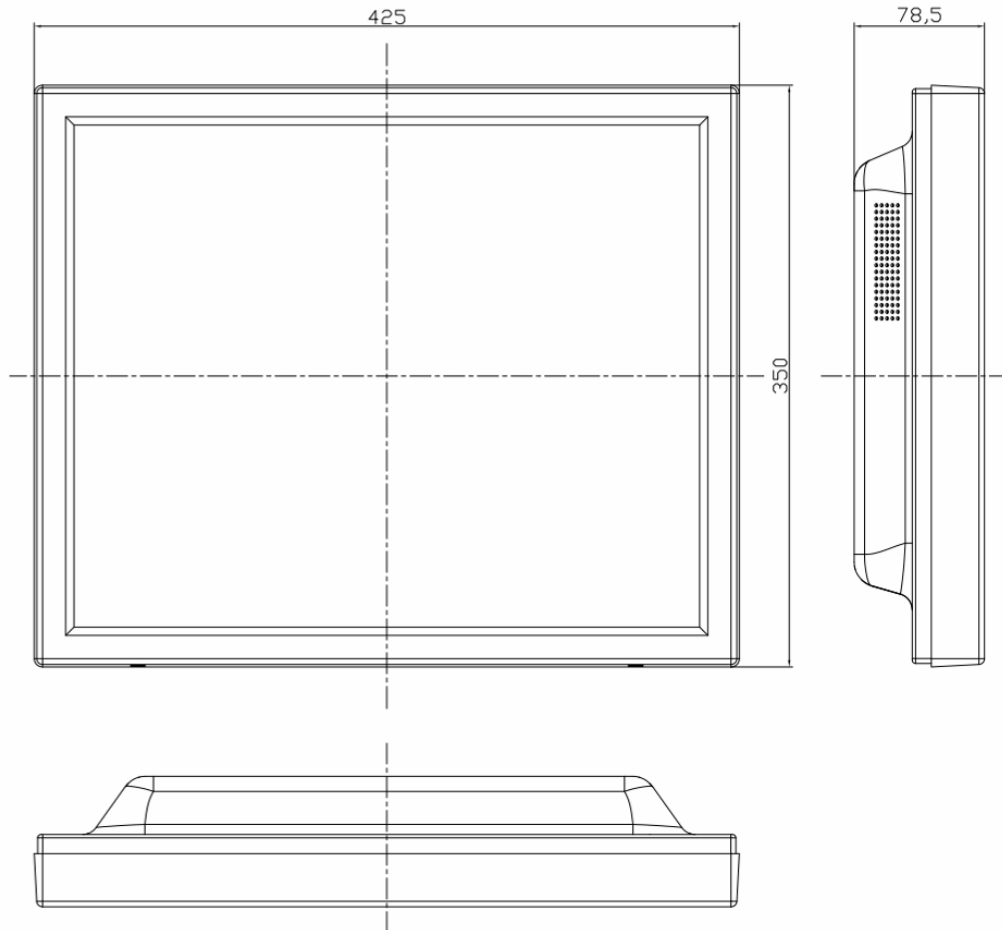
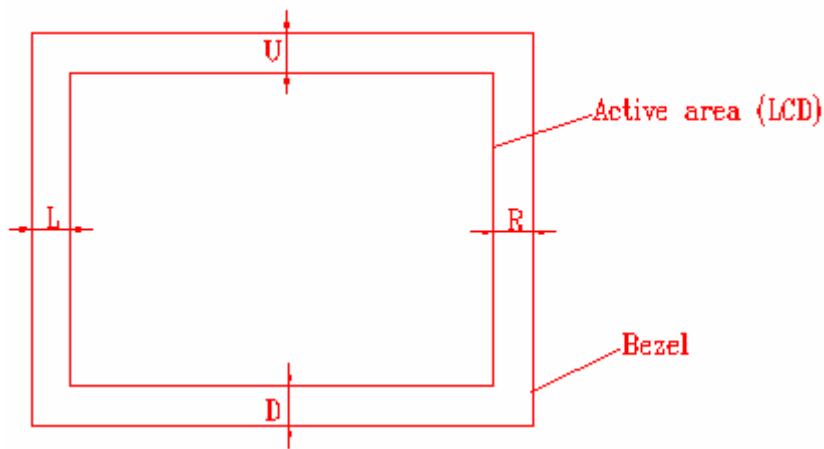


Figure 4

Item	Set	
Size of set	Width	425mm
	Height	350mm
Housing components	Aluminum	
Visible screen surface	Approx. 376mm × 301mm	
Ventilation slots	In rear panel	
Degree of protection	IP20 to DIN40050	
VESA mounting	100x100 mm	
Net weight	Approximately 5.5 Kg (without stand)	

4.2 Screen Quality

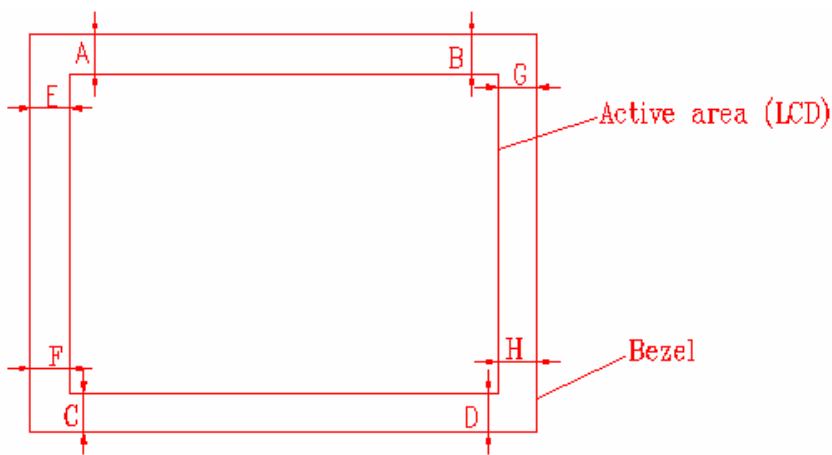
4.2.1 H/V outline position



H: $|L-R| \leq 1.0\text{mm}$

V: $|U-D| \leq 1.0\text{mm}$

4.2.2 Outline edge position



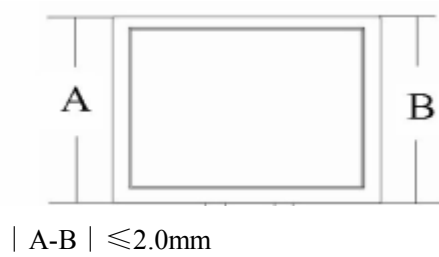
$|A-B| \leq 1.0\text{mm}$

$|C-D| \leq 1.0\text{mm}$

$|E-F| \leq 1.0\text{mm}$

$|G-H| \leq 1.0\text{mm}$

4.2.3 Structure width position



4.3 Packaging

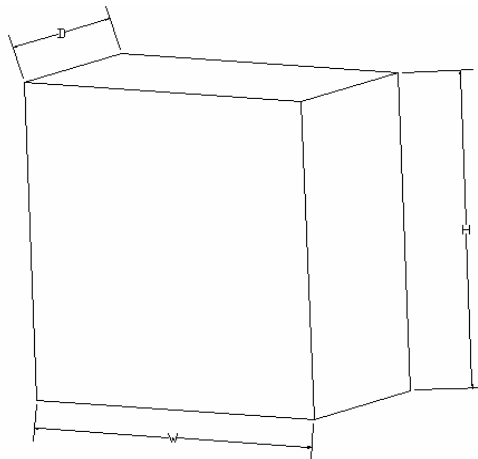


Figure 5

4.3.1 Package dimension and weight

	Box	
Outer size of box	Width (mm)	545
	Depth (mm)	195
	Height (mm)	470
Gross weight	Approximately 7.5Kg	

5. ENVIRONMENT CONDITONS

5.1 Operation Temperature

Ambient temperature range	10 to 40 deg. C
Ambient humidity	10% -80% (non-condensing)
Temperature gradient	Max. 5°C/h , no condensation
Altitude	700 to 1060 hPa

5.2 Transport and storage (Packed)

Ambient temperature range	-20 -- +60°C
Ambient humidity	5%-90%
Temperature gradient	Max. 10°C/h, no condensation
Altitude	70 – 106 kPa

5.3 Mechanical requirements

Operation

Vibration	According to EN60068-2-6 10--58 Hz within ± 0.075 mm deflection 58—500 Hz at 10 m/s ²
Shock	According to EN 60068-2-27 (single shock) 150m/s ² , 6ms No permanent shock allowed in operating conditions

Packed unit

Vibration	According to EN60068-2-6 5--9 Hz within ± 3.5 mm deflection 9—500 Hz at 10 m/s ²
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Shock	According to EN 60068-2-27 (single shock) 250m/s ² , 6ms(in storage packing) According to EN 60068-2-29 (permanent shock)
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5.4 Drop Test (packed)

	Position	Height
Corner	1	76.0cm
Edge	3,2,4	76.0cm
Surfaces	A,B,C,D	76.0cm
	E	76.0cm
	F	76.0cm
(Cushion should be changed to new one.)		
Corner	5	76.0cm
Edge	6,7	76.0cm

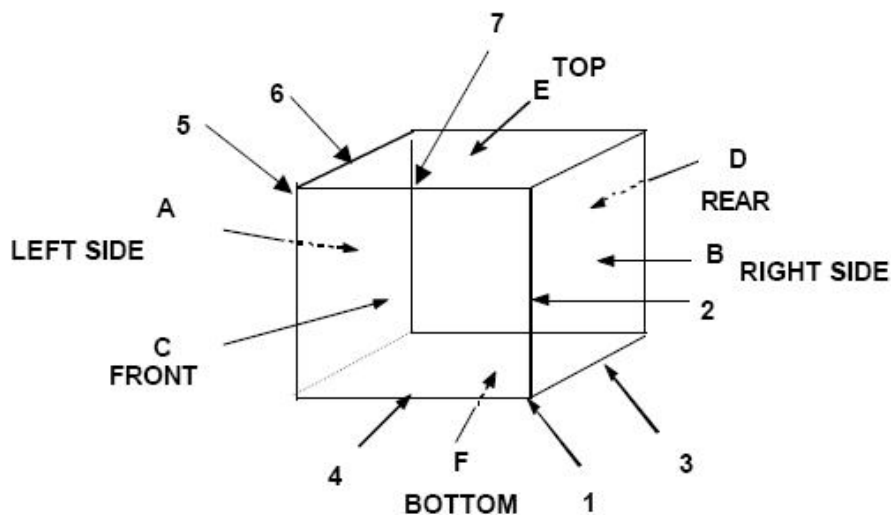


Figure 6

5.5 Safety specifications

Safety standards	IEC 60601-1:2005, ANSI/AAMI ES60601-1:2005 & CSA C22.2 No.60601-1:2008,EN60601-1, EN60601-1-2, GB4943.1-2011 , GB9254-2008 , GB17625.1-2012, FCC Part15
Approvals	cTUVus, CCC, CB ,FCC

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Protection class	Protection class I
Degree of protection to DIN 40050	IP 20
Conformity	CE

5.6 Electromagnetic compatibility

Refer to GE EMC GUIDANCE DOC0436391.

5.7 MTBF

Flat screen without Backlight: 50,000 operation hours.

Flat screen with Backlight: 30,000 operation hours.

6. DEFECT, SCRATCH and DUST

Inspection Standards for LCD Modules

1.Description

These inspection standards shall be applied to LCD Module supplied by INNOLUX Corporation.

2.The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature : 20~30℃
- (2) Humidity: 25~75 %RH
- (3) External appearance inspection shall be conducted by using a single 20W fluorescent lamp or equivalent illumination.
- (4) Basic Conditions:
 - (a) Viewing Distance:
350 to 500 mm
 - (b) Ambient Illumination:
20 to 100 lux for light on inspection
 - (c) Ambient Illumination:
300 to 700 lux for external appearance inspection
 - (d) At converter duty 40%.
 - (e) Viewing Angle:
± 40 degree to the front surface of display panel in vertical and horizontal direction when power ON.

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3. Classification of defects

Defects are classified two types, major defect and minor defect according to the defect. And, the definition of defects is classified as below.

(1) Major defect

Any defect may result in functional failure, or reduce the usability of product for its purpose. For example, electrical failure, deformation and etc..

(2) Minor defect

A defect that is not to reduce the usability of product for its intended purpose and un-uniformity, dot defect and etc..

The criteria on major and/or minor judgement will be according with the classification of defects.

4. Inspection Criteria

4.1 Display Inspection

(1) Bright, Black Dots and mura (white, black spot)

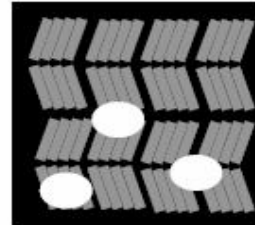
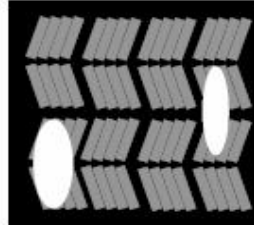
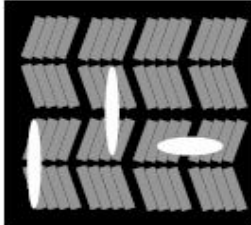
The following Table describes the specification of bright and black dots in the visual screen quality of the TFT-LCD module at power-ON.

Items	Specification
Partial Bright Dots	$N \leq 3$
Full Bright Dots	$N \leq 0$
Full Black Dots	$N \leq 5$
Total Partial Bright Dots and Black Dots	$N \leq 6$
Two Joined Partial Bright Dots	$N \leq 1$
Two Joined Black Dots	$N \leq 1$
Three Joined Partial Bright Dots	$N \leq 0$
Three Joined Black Dots	$N \leq 0$
Total of Partial Bright and Partial Black Pixels within a circle of 10mm diameter	$N \leq 3$
Definitions:	
(1) A Partial Bright Dot is a lit Dot visible through 3% ND filter under all black background. If a lit can not be seen through 3% ND filter, it is not counted as a partial bright dot. This measurement condition is at converter duty 35%. The Partial Bright Dot size is smaller than 1 Full Bright Dot.	
(2) Viewing Angle: ± 40 degree to the front surface of display panel in vertical and horizontal direction when power ON.	

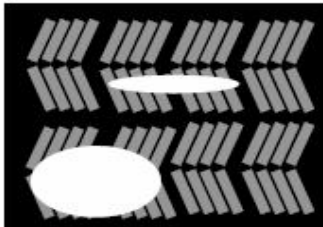
Full Dot



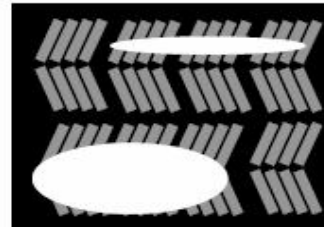
Partial Dot Defect



Two Joined Partial Dot Defect



Three Joined Partial Dot Defect



(2)Line Defect

Line defect is defined as a horizontal or vertical line that differs from adjacent lines in brightness at any gray level. Line defects will not exist anywhere on the screen.

4.2 Appearance inspection

(1) Visual Screen Quality

The following Table describes the visual screen quality of the general TFT-LCD module at power-off and power-on for foreign material.

Polarizer Scratch/Bubble	Size (mm)	Allowable maximum counts
Elliptical defects	$D < 0.20$	Disregarded
	$0.20 \leq D < 0.40$	5
	$0.40 \leq D$	0
Linear defects	$W < 0.07$	Disregarded
	$0.07 \leq W < 0.10$ and $L < 3.0$	5
	$0.10 \leq W$	0

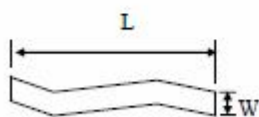
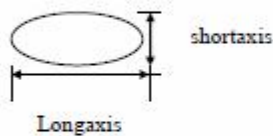
Definition:

$$\text{Elliptical defects} \quad \frac{\text{Longaxis}}{\text{shortaxis}} < 10x,$$

$$\text{Linear defects :} \quad \frac{\text{Longaxis}}{\text{shortaxis}} \geq 10x$$

D : diameter

$$D = \frac{\text{long axis} + \text{short axis}}{2}$$



W: width, L: length

5.External Appearance Inspection Criteria

Item	Contents	
Screw	Parts mounting, incomplete assembly, deformation, oxidized, crooked or rusty is not permitted.	
Metal frame (Bezel)	Scratch	*Noticeable scratch and exfoliation coating are not permitted. *The oxidized metal is not permitted.
	Incomplete assembly is not permitted.	
Backlight	Scratch	The scratch which may causes a problem in practical use is not permitted.
	Break-off	Breaking off is not permitted.
	Crack	The crack is not permitted.
Stain on Polarizer	The stain which can't be wiped off is not permitted.	
Tape/Label	Incorrect position, missed label is not permitted.	
Connector	Oxidized/rusty connector is not permitted.	
Outline size	Spec. out is not permitted.	

6.Classification of defects

Inspection Item	Criteria and Description	Judgement
Vertical line	Signal input, vertical line off or irregular V-line appears	Not permit
Horizontal line	Signal input, horizontal line off or irregular H-line appears	Not permit
Cross line	Pattern signal input, a correct display is not obtained	Not permit
No display	Signal input, display is dead	Not permit
Irregular display	Pattern signal input, a correct display is not obtained	Not permit
Pixels defect	Exceed specified standards	4.1-(1)
Scratch and Dent on polarizer	Exceed specified standards	4.2-(1)
Foreign material	Exceed specified standards	4.2-(1)
Mura	Not visible through 10% ND filter in general situation or special case judged by limit sample	ND filter or Limit sample
External Appearance	Rust, deformation, irregular plating, coating missing etc. A appearance defect that do not affect function or performance	Permit
Bezel claw	Bezel claw missing or not bent	Not permit
Polarizer bubble	Exceed specified standards	4.2-(1)

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7. Image Retention

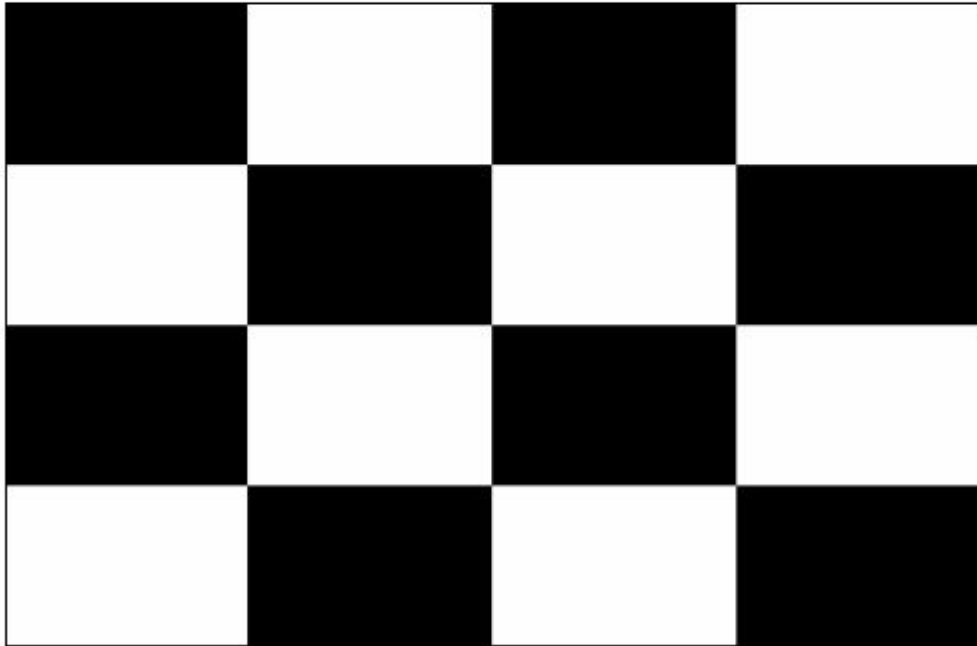
The panel spec of image retention is as follows.

Test method: The L0/L255 Mosaic pattern below is displayed for the display time

Then, change the pattern to L128 all gray pattern and count the time

Spec for Image retention time is below.

Display Time	5sec	60sec
Time until disappearing	5 sec	15 sec



Other Issues which are not defined in these criteria, shall be discussed with both parties, Customer and Supplier, for better solution.

Dust between LCD and touch screen :

Items		Criteria	
Dust	Linear (mm)	$L \leq 5, N \leq 3$ No dust gathered	
	Circular(mm^2)	$S \leq 0.05$	Allowed
		$0.05 < S \leq 0.2$	$N \leq 4$
		$0.2 < S \leq 0.3$	$N \leq 2$
		$S > 0.3$	Not Allowed

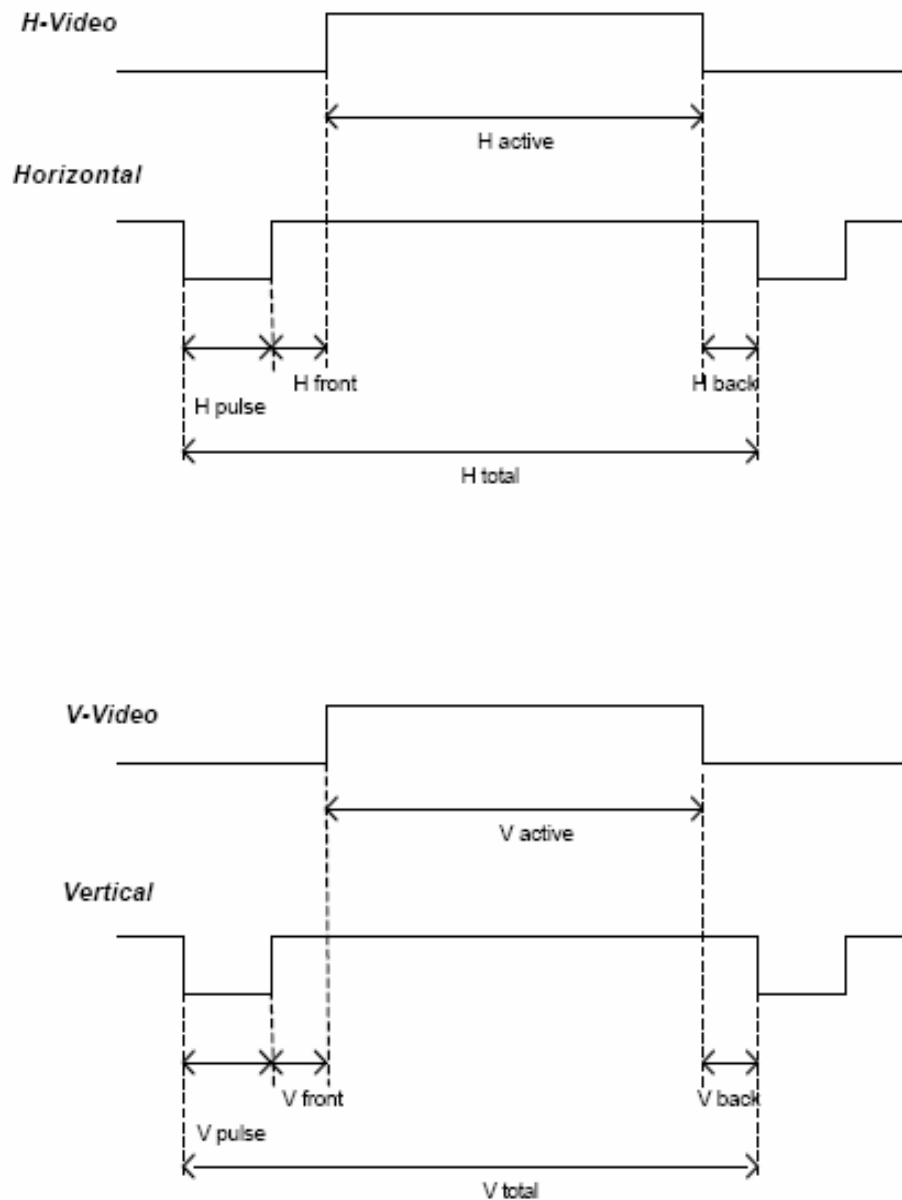
7. NOTICE FOR HANDING

Handing

- (1) When the module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist or bend the modules.
- (2) Because the inverters use high voltage, power should be disconnected before it is assembled or disassembled.
- (3) Refrain from string mechanical shock and /or any force to the module. In addition to damage, this may cause improper operation or the module and CCFT backlight.
- (4) Note that polarizes are very fragile and could be easily damaged. Do not press or scratch the surface using the harder than a HB pencil lead.
- (5) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.
- (6) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (7) 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 damage to the polarizer due to chemical reaction.
- (8) 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 cloths, it must be washed away thoroughly with soap.
- (9) Protect the module from static which may cause damage to the CMOS Gate Array IC.
- (10) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (11) Do not disassemble the module.
- (12) Do not pull or fold the lamp wire.
- (13) Do not adjust the variable resistor located on the module.
- (14) Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (15) Pins of I/F connector should not be touched directly with bare hands.

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Appendix 1 Preset Timings



Detailed timing comply with VESA specification.

Display Mode	Horizontal Frequency (kHz)	Vertical Frequency (Hz)	Pixel Clock (MHz)	Sync Polarity (Horizontal/Vertical)
VGA, 720 x 400	31.5	70.1	28.3	-/+
VGA, 640 x 480	31.5	59.9	25.2	-/-
VESA, 640 x 480	37.5	75.0	31.5	-/-
VESA, 800 x 600	37.9	60.3	40.0	+/+
VESA, 800 x 600	46.9	75.0	49.5	+/+

VESA, 1024 x 768	48.4	60.0	65.0	-/-
VESA, 1024 x 768	60.0	75.0	78.8	+/+
VESA, 1152 x 864	67.5	75.0	108.0	+/+
VESA, 1280 x 1024	64.0	60.0	108.0	+/+
VESA, 1280 x 1024	76.7	71.96	135.0	+/-
VESA, 1280 x 1024	80.0	75.0	135.0	+/+