



## **Engineering Specification**

**Type 12.1 XGA Color TFT/LCD Module**

**Model Name: IAXG02S**

**Document Control Number: OEM I-902S-05**

**Note: Specification is subject to change without notice. Consequently it is better to contact International Display Technology before proceeding with the design of your product incorporating this module.**

**International Display Technology**



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## ii Record of Revision

Date	Document Revision	Page	Summary
October 6,2004	OEM I-902S-05	All	First Edition for customer.

## 1.0 Handling Precautions

- If any signals or power lines deviate from the power on/off sequence, it may cause shorten the life of the LCD module.
- The LCD panel and the CFL are made of glass and may break or crack if dropped on a hard surface, so please handle them with care.
- CMOS ICs are included in the LCD panel. They should be handled with care, to prevent electrostatic discharge.
- Do not press the reflector sheet at the LCD module to any directions.
- Do not stick the adhesive tape on the reflector sheet at the back of the LCD module.
- Please handle with care when mount in the system cover. Mechanical damage for lamp cable/lamp connector may cause safety problems.
- Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (2.5, IEC60950 or UL60950), or be applied exemption conditions of flammability requirements (4.7.3.4, IEC60950 or UL60950) in an end product.
- The LCD module is designed so that the CFL in it is supplied by Limited Current Circuit (2.4, IEC60950 or UL60950).
- The fluorescent lamp in the liquid crystal display(LCD) contains mercury. Do not put it in trash that is disposed of in landfills. Dispose of it as required by local ordinances or regulations.
- Never apply detergent or other liquid directly to the screen.
- Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth; do not use solvents or abrasives.
- Do not touch the front screen surface in your system, even bezel.
- Gently wipe the covers and the screen with a soft cloth.

- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by International Display Technology for any infringements of patents or other right of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of International Display Technology or others.

## 2.0 General Description

This specification applies to the Type 12.1 Color TFT/LCD Module 'IAXG02S'.

This module is designed for a display unit of a notebook style personal computer.

The screen format and electrical interface are intended to support the XGA (1024(H) x 768(V)) screen.

Support color is native 262k colors ( RGB 6-bit data driver ).

All input signals are LVDS (Low Voltage Differential Signaling) interface compatible.

This module does not contain an inverter card for backlight.

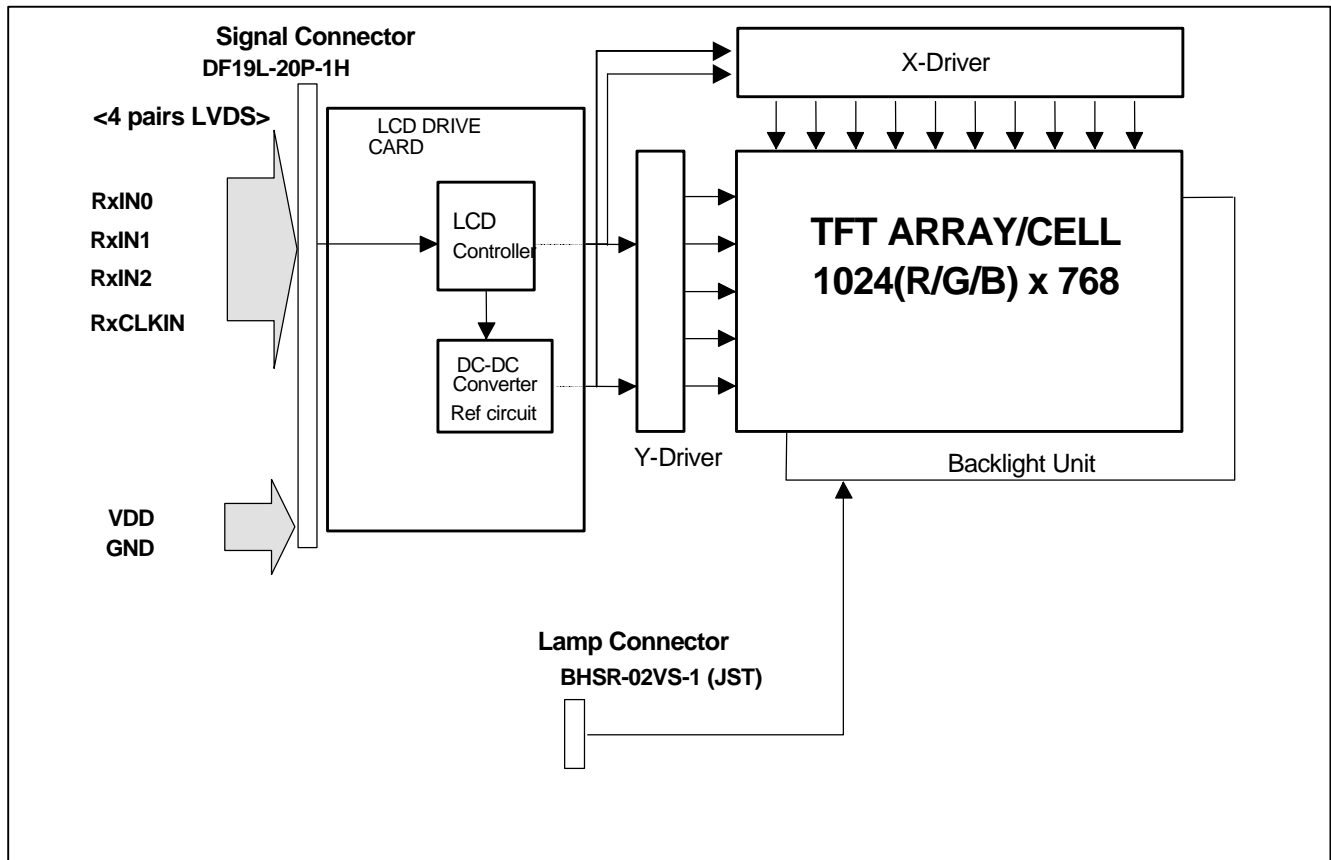
## 2.1 Characteristics

The following items are characteristics summary on the table under 25 degree C condition:

CHARACTERISTICS ITEMS	SPECIFICATIONS
Screen Diagonal [cm]	307.2
Active Area [mm]	245.76(H) x 184.32(V)
Pixels H x V [pixels]	1024(x3) x 768
Pixel Pitch [mm]	0.240(per one triad) x 0.240
Pixel Arrangement	R.G.B. Vertical Stripe
Display Mode	Normally White
Display Surface Treatment	Anti-Glare (ARC150-T)
White Luminance [cd/m <sup>2</sup> ]	150 Typ. (Screen Center, ICFL = 6.0mA)
Contrast Ratio	250 : 1 Typ.
Optical Rise Time+Fall Time [msec]	50 Max.
Nominal Input Voltage [Volt]	+3.3 Typ. (VDD)
Logic Power Consumption [watt]	0.7 Typ. (VDD=3.3V, All Black Pattern Clock frequency=54MHz)
Backlight Power Consumption [watt]	3.4 Typ. (@CFL current 6.0mA )
Weight [grams]	260 Typ (TBD)..,270 Max.
Physical Size [mm]	261.0(W) x 198.0(H) x 4.7(D) Typ. (without Inverter)
Electrical Interface	4 pairs LVDS(R/G/B Data (6-bit), 3 sync signals, Clock)
Support Color	Native 262K colors ( RGB 6-bit data driver )
Temperature Range [deg. C]	0 to +50 (Operating) -20 to +60 (Storage, Shipping)
CFL Cable Length [mm]	44 Typ

## 2.2 Functional Block Diagram

The following diagram shows the functional block of the Type 12.1 Color TFT/LCD Module.



### 3.0 Absolute Maximum Ratings

Absolute maximum ratings of the module is as follows:

Item	Symbol	Min	Max	Unit	Conditions
Supply Voltage	VDD	-0.3	+4.0	V	
Input Voltage of Signal	Other Inputs	-0.3	VDD+0.3	V	
Lamp Ignition Voltage	V <sub>inv</sub>	-	+1,800	V <sub>rms</sub>	Ta = 0 [deg.C]
CFL Current	ICFL	-	7	mArms	
CFL Peak Inrush Current	ICFLP	-	20	mArms	Ta = 25 [deg.C] (Note 1)
Operating Temperature	TOP	0	+50	deg.C	(Note 2)
Operating Relative Humidity	HOP	8	95	%RH	(Note 2)
Storage Temperature	TST	-20	+60	deg.C	(Note 2)
Storage Relative Humidity	HST	5	95	%RH	(Note 2)
Vibration			1.5 10-200	G Hz	
Shock			50 18	G ms	Rectangle wave

**Note:**

1. Duration : 50 [msec] Max.
2. Maximum Wet-Bulb should be 39 degree C and No condensation.

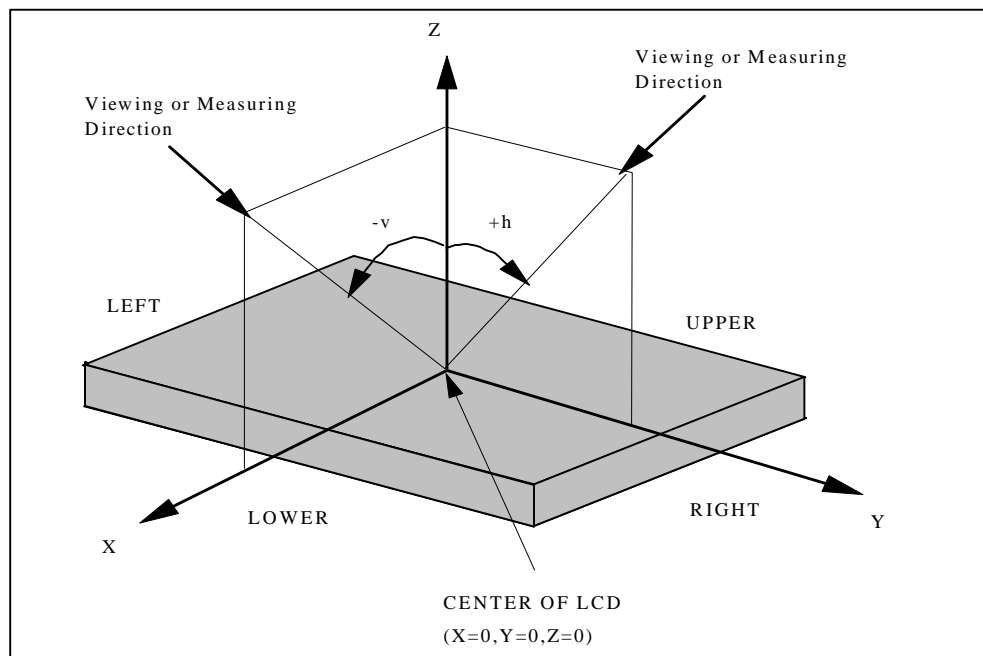
## 4.0 Optical Characteristics

The optical characteristics are measured under stable conditions as follows under 25 degree C condition:

Item	Conditions	Specification	
		Typ.	Note
Viewing Angle (Degrees)	Horizontal (Right)	40	-
	$K \geq 10$ (Left)	40	-
	Vertical (Upper)	15	-
K: Contrast Ratio	$K \geq 10$ (Lower)	30	-
Contrast ratio		250	-
Response Time (ms)	Rising + Falling	-	50 Max.
Color Chromaticity (CIE)	Red x	0.577	
	Red y	0.338	
	Green x	0.310	
	Green y	0.554	
	Blue x	0.158	
	Blue y	0.124	
	White x	0.313	
	White y	0.329	
White Luminance ( $\text{cd/m}^2$ ) ICFL 6.0 mA		150Typ. Center 140Typ. 5 points average	120 Min. Center 112 Min. 5 points average



The following is the note for the Optical Characteristics:



- Chromaticity and White Balance are defined as the C.I.E. 1931 x,y coordinates at the center of LCD. The Measurement Equipment are as shown below table.

Item	Measuring Equipment
Viewing Angle	MCPD-7000 by Ohtsuka Elec
Contrast	MCPD-7000 by Ohtsuka Elec
Response Time	BM5A by TOPCON OPTICAL Co.,Ltd.
White Luminance	MCPD-7000 by Ohtsuka Elec
Luminance Uniformity	MCPD-7000 by Ohtsuka Elec
Chromaticity	MCPD-7000 by Ohtsuka Elec
White Balance	MCPD-7000 by Ohtsuka Elec

The measurement is to be done after 30 minutes of Power-on of BackLight.

Unless otherwise specified, the ambient conditions are as following.

Ambient Temperature	:	25	+	2	( degreeC )
Ambient Humidity	:	25	-	85	( % )
Atmospheric Pressure	:	86.0	-	104.0	( kPa )



## 5.0 Signal Interface

### 5.1 Connectors

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

Connector Name / Designation	For Signal Connector
Manufacturer	HIROSE
Type / Part Number	DF19L-20P-1H
Mating Receptacle/Part Number	DF19G-20S-1F (FPC Type) / DF19G-20S-1C(Cable Type) DF19G-20S-1C (Cable Type)

Connector Name / Designation	For Lamp Connector
Manufacturer	JST
Type / Part Number	BHSR-02VS-1
Mating Type / Part Number	SM02B-BHSS-1

## 5.2 Interface Signal Connector

Pin#	Signal
1	GND
2	GND
3	Reserved
4	Reserved
5	GND
6	RxCLKIN+
7	RxCLKIN-
8	GND
9	RxIN2+
10	RxIN2-

Pin#	Signal
11	GND
12	RxIN1+
13	RxIN1-
14	GND
15	RxIN0+
16	RxIN0-
17	GND
18	GND
19	VDD
20	VDD

**Note:**

1. 'Reserved' pins are not allowed to connect any other line.
2. Voltage levels of all input signals are LVDS compatible. Refer to "Signal Electrical Characteristics for LVDS", for voltage levels of all input signals.

## 5.3 Interface Signal Description

### Signal Description

Signal Name	Description
RxIN0+, RxIN0-	LVDS differential data input (RED0-RED5, GREEN0)
RxIN1+, RxIN1-	LVDS differential data input (GREEN1-GREEN5, BLUE1)
RxIN2+, RxIN2-	LVDS differential data input (BLUE2-BLUE5, HSYNC, VSYNC, DSPTMG)
RxCLKIN+, RxCLKIN-	LVDS differential clock input(DTCK)
VDD	+3.3V Power Supply
GND	Ground

**Note:**

- The module uses a 100ohm resistor between positive and negative data lines of each receiver input.
- Input signals shall be low or Hi-Z state when VDD is off.

SIGNAL NAME	Description	
+RED5	Red Data 5 (MSB)	Red-pixel Data Each red pixel's brightness data consists of these 6 bits pixel data.
+RED4	Red Data 4	
+RED3	Red Data 3	
+RED2	Red Data 2	
+RED1	Red Data 1	
+RED0	Red Data 0 (LSB)	
+GREEN 5	Green Data 5 (MSB)	Green-pixel Data Each green pixel's brightness data consists of these 6 bits pixel data.
+GREEN 4	Green Data 4	
+GREEN 3	Green Data 3	
+GREEN 2	Green Data 2	
+GREEN 1	Green Data 1	
+GREEN 0	Green Data 0 (LSB)	
+BLUE 5	Blue Data 5 (MSB)	Blue-pixel Data Each blue pixel's brightness data consists of these 6 bits pixel data.
+BLUE 4	Blue Data 4	
+BLUE 3	Blue Data 3	
+BLUE 2	Blue Data 2	
+BLUE 1	Blue Data 1	
+BLUE 0	Blue Data 0 (LSB)	
DTCLK	Data Clock	The typical frequency is 65.0 MHz. The signal is used to strobe the pixel data and DSPTMG signals.
DSPTMG	Display Timing	When the signal is high, the pixel data shall be valid to be displayed.
VSUNC	Vertical Sync	
HSUNC	Horizontal Sync	

**Note:** Output signals from any system shall be low or Hi-Z state when VDD is off.

## 5.4 Interface Signal Electrical Characteristics

### 5.4.1 Signal Electrical Characteristics for LVDS Receiver

The LVDS receiver equipped in this LCD module is compatible with ANSI/TIA/TIA-644 standard.

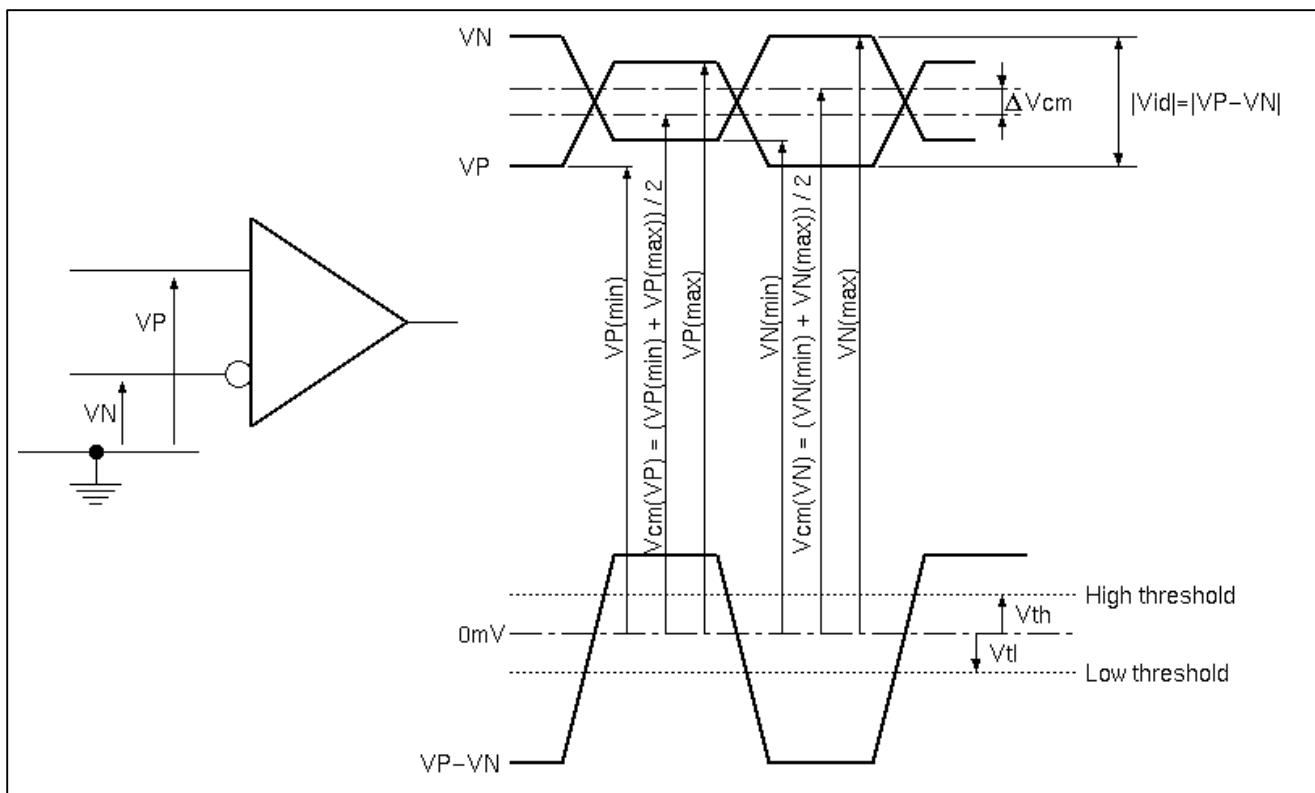
#### Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Differential Input High Threshold	Vth			+100	mV	Vcm=+1.2V
Differential Input Low Threshold	Vtl	-100			mV	Vcm=+1.2V
Magnitude Differential Input Voltage	Vid	100		600	mV	
Common Mode Voltage	Vcm	1.0	1.2	1.4	V	Vth - Vtl = 200mV
Common Mode Voltage Offset	dVcm	-50		+50	mV	Vth - Vtl = 200mV

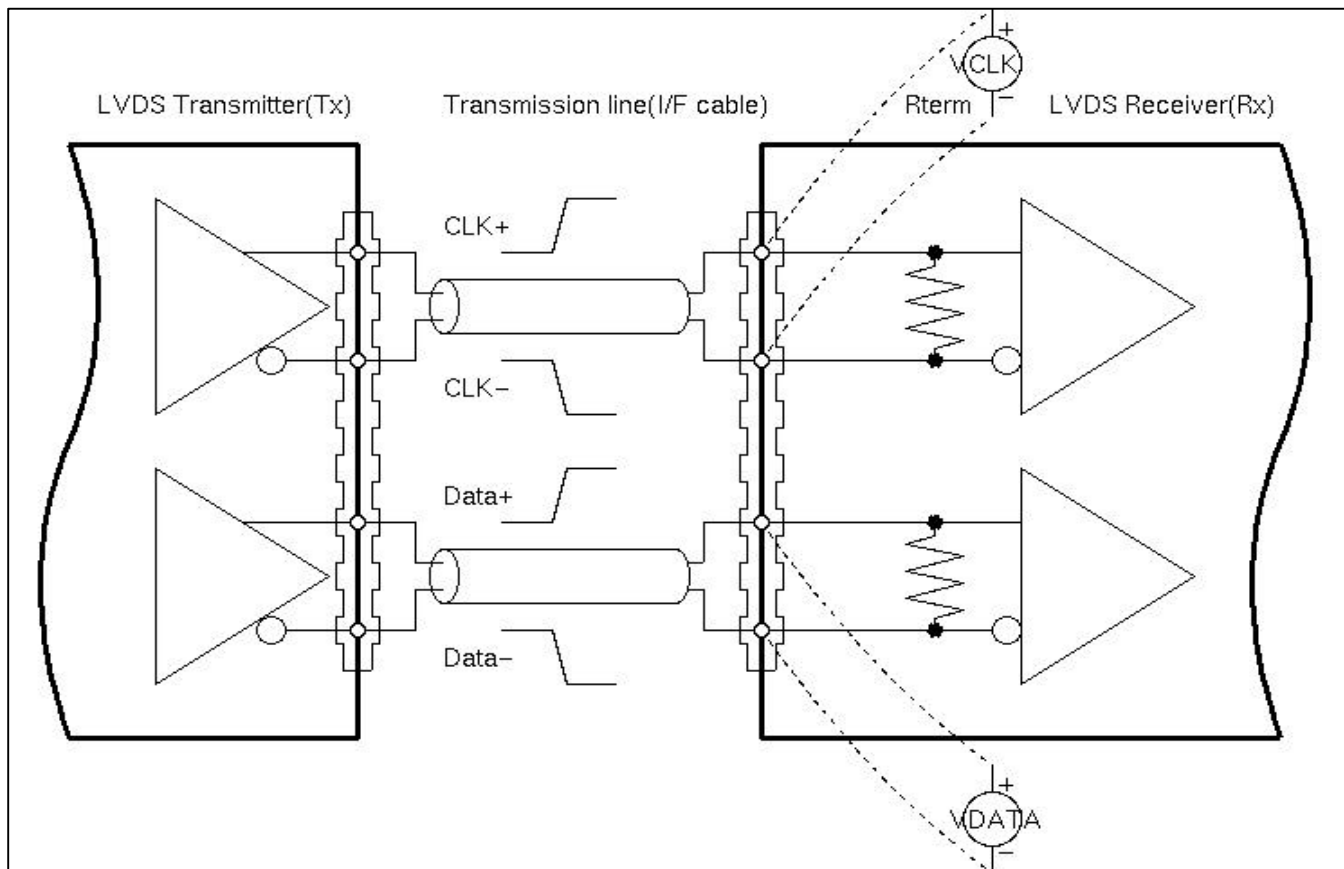
#### Note:

- Input signals shall be low or Hi-Z state when VDD is off.
- All electrical characteristics for LVDS signal are defined and shall be measured at the interface connector of LCD (See Figure "Measurement system").

#### Voltage Definitions



## Measurement System



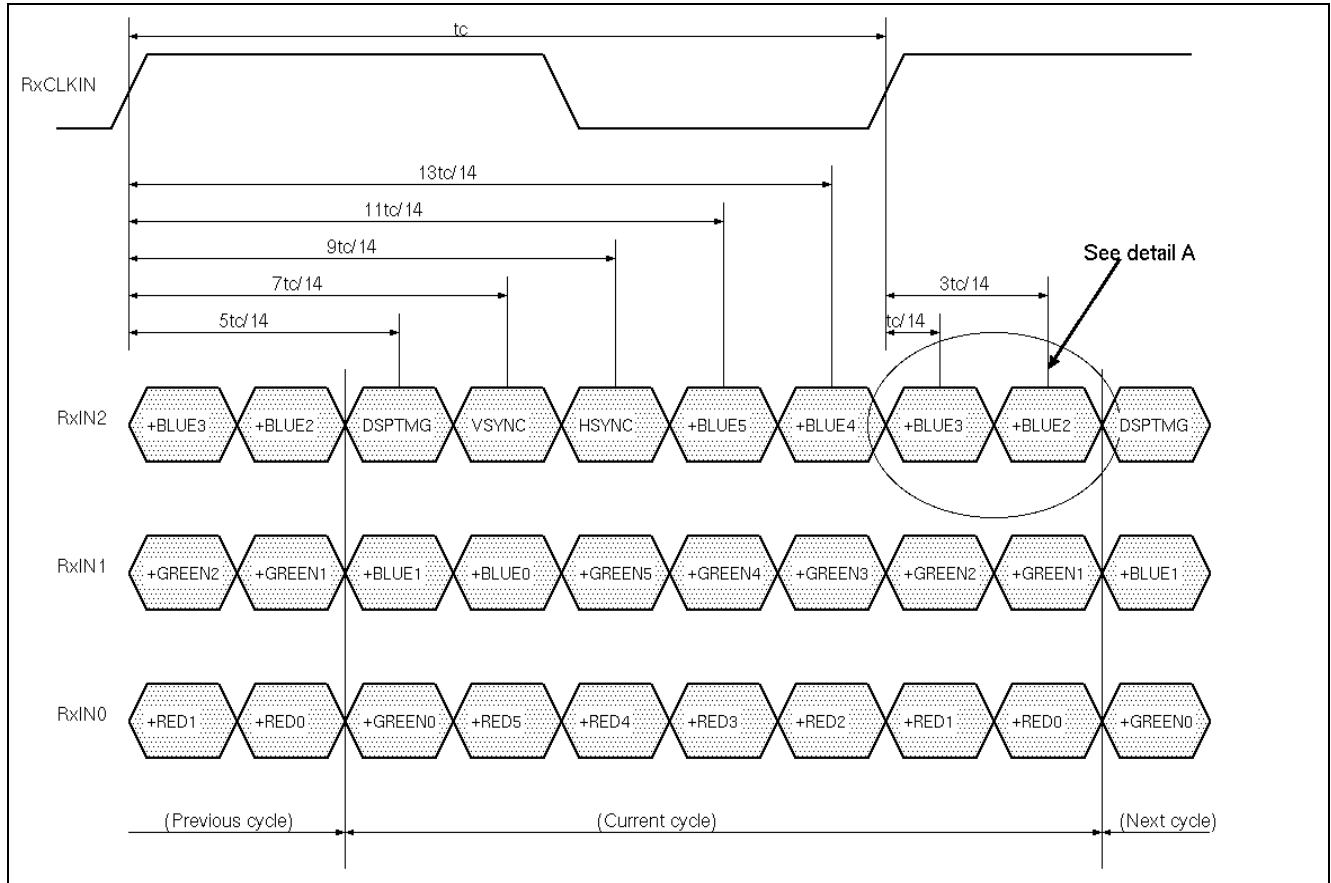
## Timing Requirements

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Clock Frequency	$f_c$	30	54.17	67	MHz	
Cycle Time	$t_c$	14.93	18.46	33.33	ns	
Data Setup Time (Note 1)	$T_{su}$	650			ps	$f_c = 54.17\text{MHz}$ , $t_{CCJ} < 50\text{ps}$ , $V_{th}-V_{tl} = 200\text{mV}$ , $V_{cm} = 1.2\text{V}$ , $dV_{cm} = 0$
Data Hold Time (Note 2)	$T_{hd}$	650			ps	
Cycle-to-cycle jitter (Note 3)	$t_{CCJ}$	-150		+150	ps	$f_c = 54.17\text{MHz}$ , $T_{su}=T_{hd}=900\text{ps}$
Cycle Modulation Rate (Note 4)	$t_{CJavg}$			20	ps/clock	$f_c = 54.17\text{MHz}$ , $T_{su}=T_{hd}=900\text{ps}$

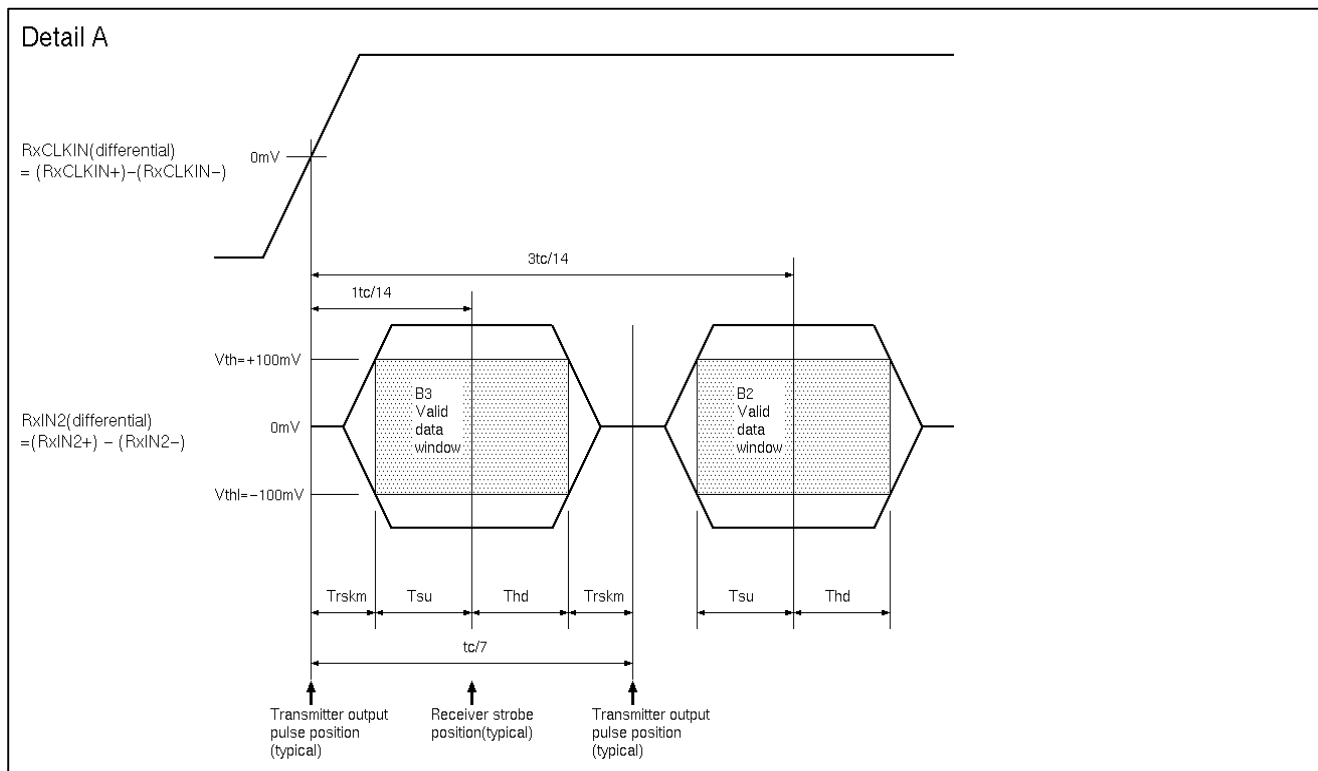
### Note:

- All values are at  $V_{DD}=3.3\text{V}$ ,  $T_a=25$  degree C.
- See figure "Timing Definition" and "Timing Definition (detail A)" for definition.
- Jitter is the magnitude of the change in input clock period.
- This specification defines maximum average cycle modulation rate in peak-to-peak transition within any 100 clock cycles. Figure "Cycle Modulation Rate" illustrates a case against this requirement. This specification is applied only if input clock peak jitter within any 100 clock cycles is greater than 300ps.

## Timing Definition

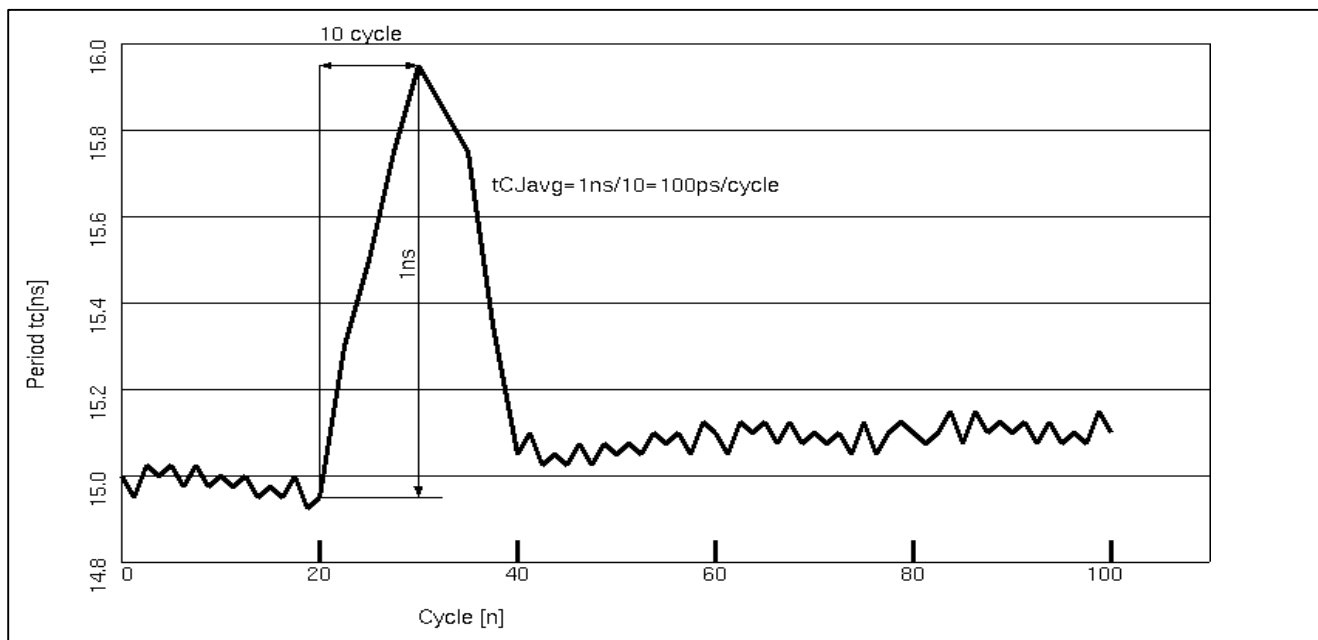


## Timing Definition (detail A)



**Note:**  $T_{su}$  and  $T_{hd}$  are internal data sampling window of receiver.  $T_{trskm}$  is the system skew margin; i.e., the sum of cable skew, source clock jitter, and other inter-symbol interference, shall be less than  $T_{trskm}$ .

## Cycle Modulation Rate

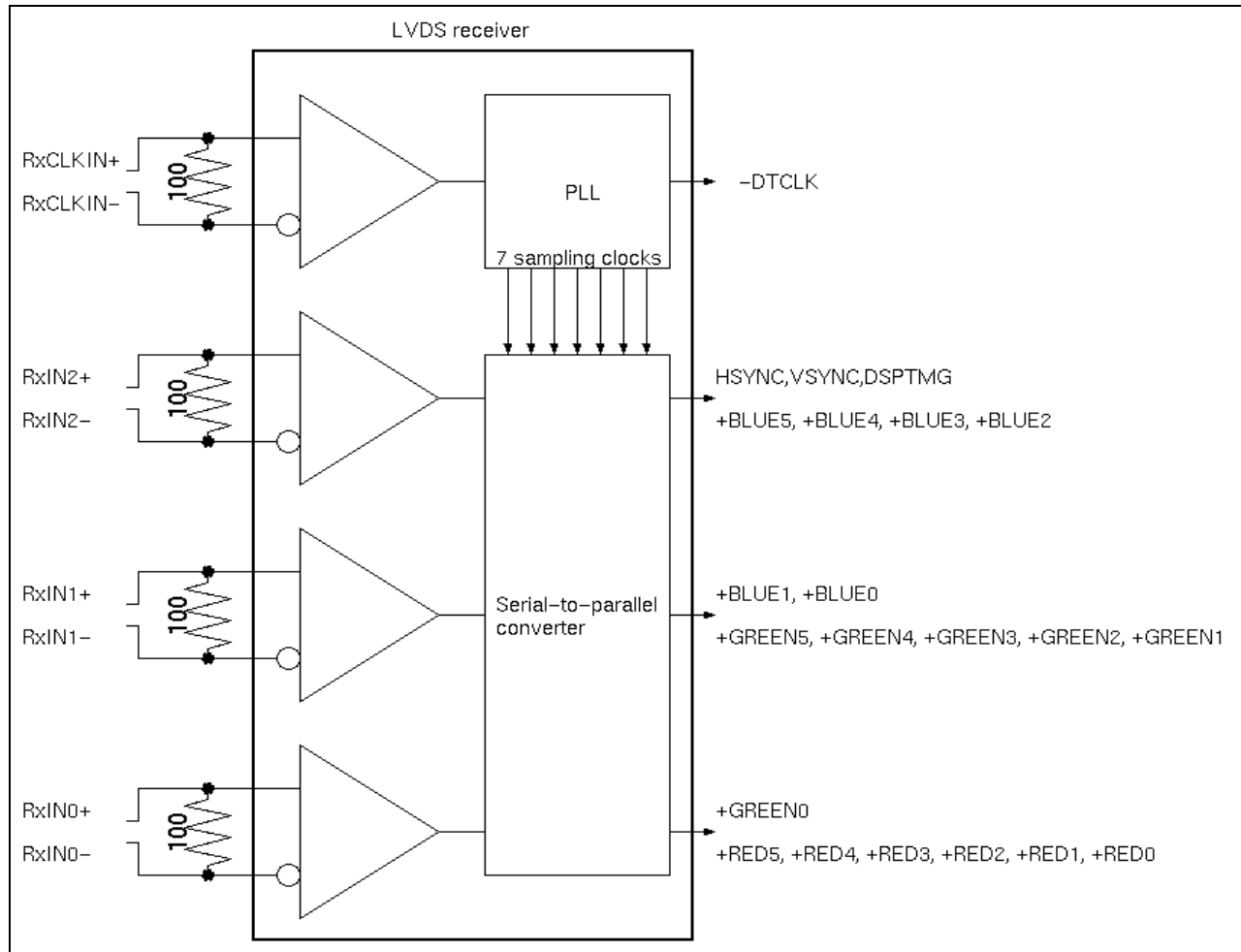




### 5.4.2 LVDS Receiver Internal Circuit

The following figure shows the internal block diagram of the LVDS receiver.

This LCD module equips termination resistors for LVDS link.



### 5.4.3 Recommended Guidelines for Motherboard PCB Design and Cable Selection

- Following the suggestions below will help to achieve optimal results.
- Use controlled impedance media for LVDS signals. They should have a matched differential impedance of 100 ohm.
- Match electrical lengths between traces to minimize signal skew.
- Isolate TEL signals from LVDS signals.
- For cables, twisted pair, twin, or flex circuit with close coupled differential traces are recommended.

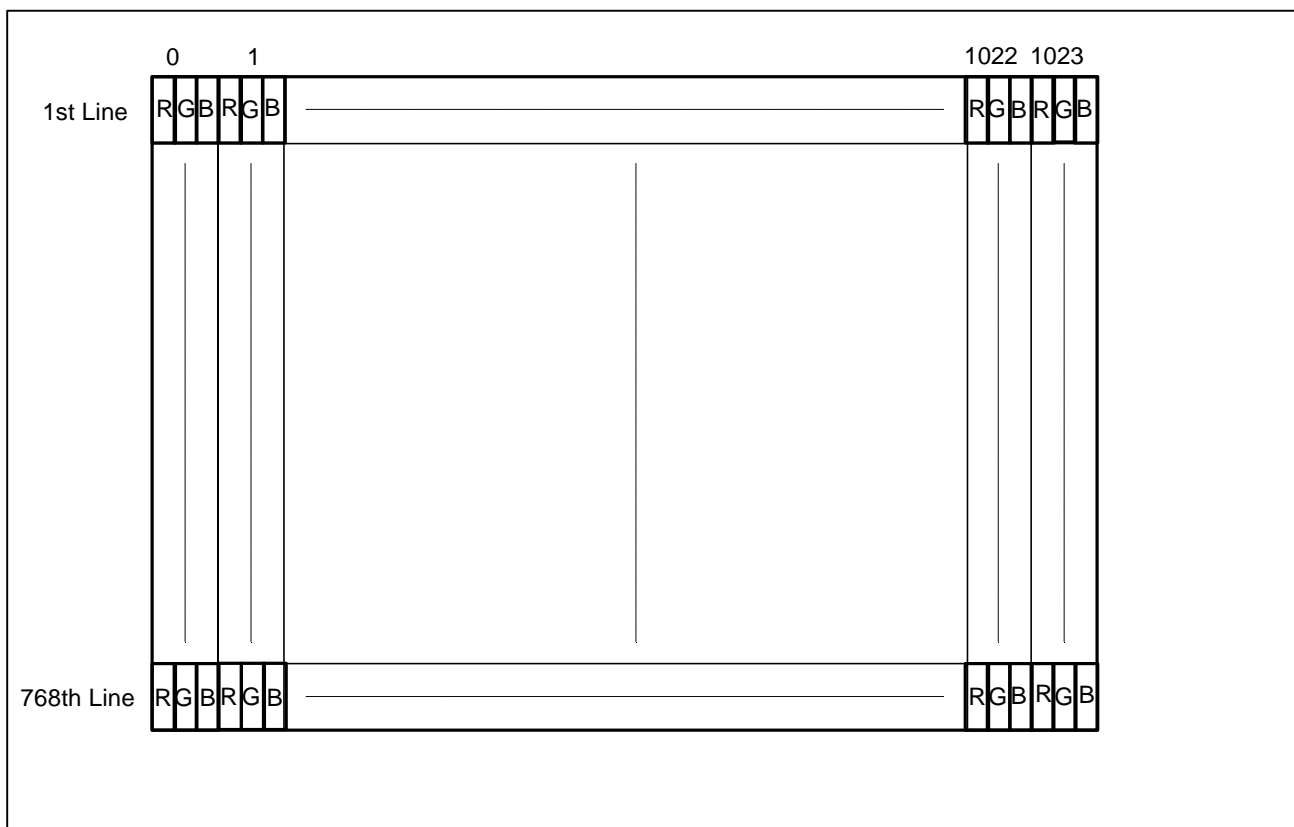
## 5.5 Signal for Lamp Connector

Pin #	Signal Name
1	Lamp High Voltage
2	Lamp Low Voltage

## 6.0 Pixel format image

Following figure shows the relationship of the input signals and LCD pixel format image.

Even and odd pair of RGB data are sampled at a time.



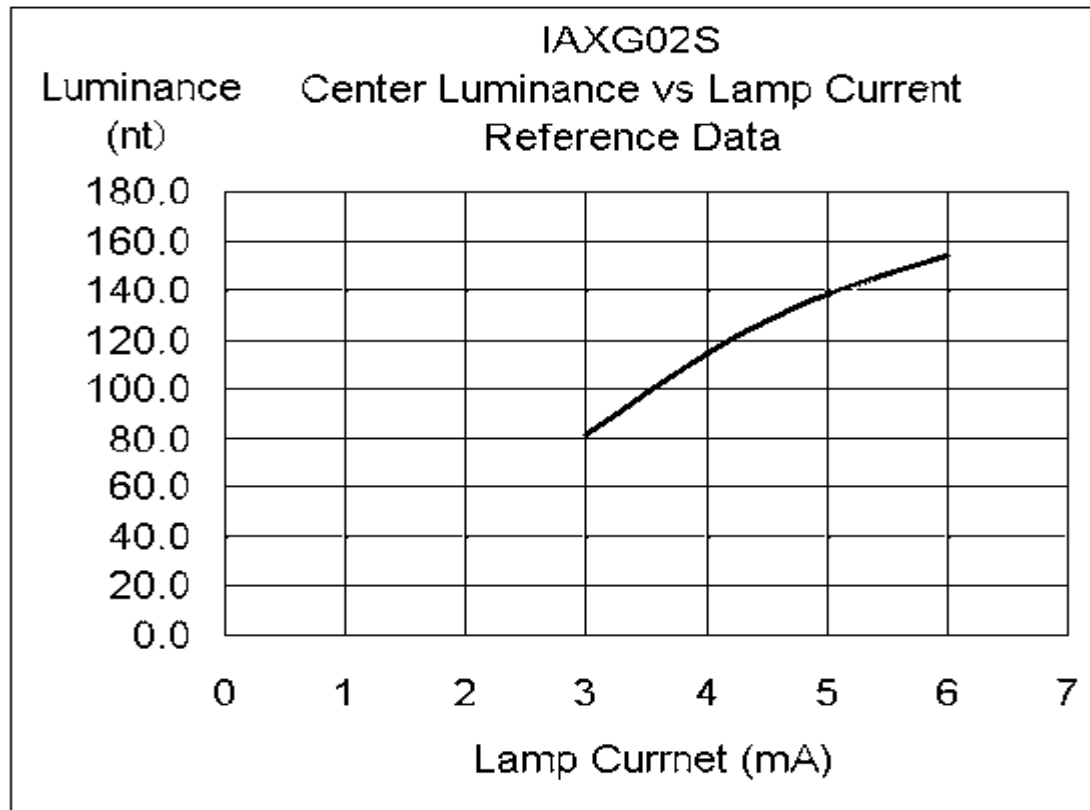
## 7.0 Parameter guide line for CFL Inverter

SYMBOL	PARAMETER	MIN	D.P (Note 1)	MAX	UNITS	CONDITION
(L63)	White Luminance (Center) (5 points average)	- -	150 140	- -	[cd/m <sup>2</sup> ] [cd/m <sup>2</sup> ]	Ta=25[deg. C]
ICFL	CFL current	3.0	6.0	7.0	[mArms]	Ta=25[deg. C] <b>(Note 2,5)</b>
RDD	Duty Dimming Ratio	20			[%]	TDDon >= 500usec
TDDon	Duty Dimming On Time	500			[usec]	
ICFLP	CFL Peak Inrush Current			20	[mA]	Ta=25[deg. C] <b>(Note 2,6)</b>
FCFL	CFL Frequency	40		70	[kHz]	Ta=25[deg. C] <b>(Note 3)</b>
VCFLi	Inverter Ignition Voltage	1400			[Vrms]	Ta=0[deg. C]
VCFL	CFL Voltage (Reference)		560		[Vrms]	Ta=25[deg. C]
PCFL	CFL Power consumption		3.4		[W]	Ta=25[deg. C] <b>(Note 4)</b>

### Note:

1. Design Point
2. If it exceeds MIN/MAX values, then "CFL Life" , "ON/OFF Cycle", and "SAFETY" will not be guaranteed.
3. CFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD.
4. Calculated value for reference (ICFL x VCFL = PCFL).
5. It should be employed the inverter which has `Duty Dimming`, if ICFL is less than 4[mA].
6. Duration: 50msec MAX

The following chart is Luminance versus Lamp Current for your reference.



## 8.0 Interface Timings

Basically, interface timings should match the VESA 1024x768 / 60 Hz (VG901101) manufacturing guide line timing. These timings described here are not actual input timings of LCD module but output timings of SN75LVDS86DGG (Texas Instruments) or equivalent.

### 8.1 Timing Characteristics

Symbol		MIN	TYP	MAX	Unit	Note
fdck	DTCLK Frequency	30.00	54.17	67.00	MHz	
tck	DTCLK cycle time	14.93	18.45	33.33	nsec	
tx	X total time	1324	1344	2047	tck	
tacx	X active time	1024	1024	1024	tck	
Hsync	H frequency		40.305		KHz	
Hsw	H-Sync width	8	136		tck	<b>1</b>
Hbp	H back porch	8	160		tck	<b>1</b>
Hfp	H front porch	0	24		tck	
ty	Y total time	779	806	1023	tx	
tacy	Y active time	768	768	768	tx	
Vsync	Frame rate	28	50	61	Hz	<b>3</b>
Vw	V-sync Width	1	6		tx	
Vfp	V-sync front porch	1	3		tx	
Vbp	V-sync back porch	9	29	63	tx	<b>2</b>

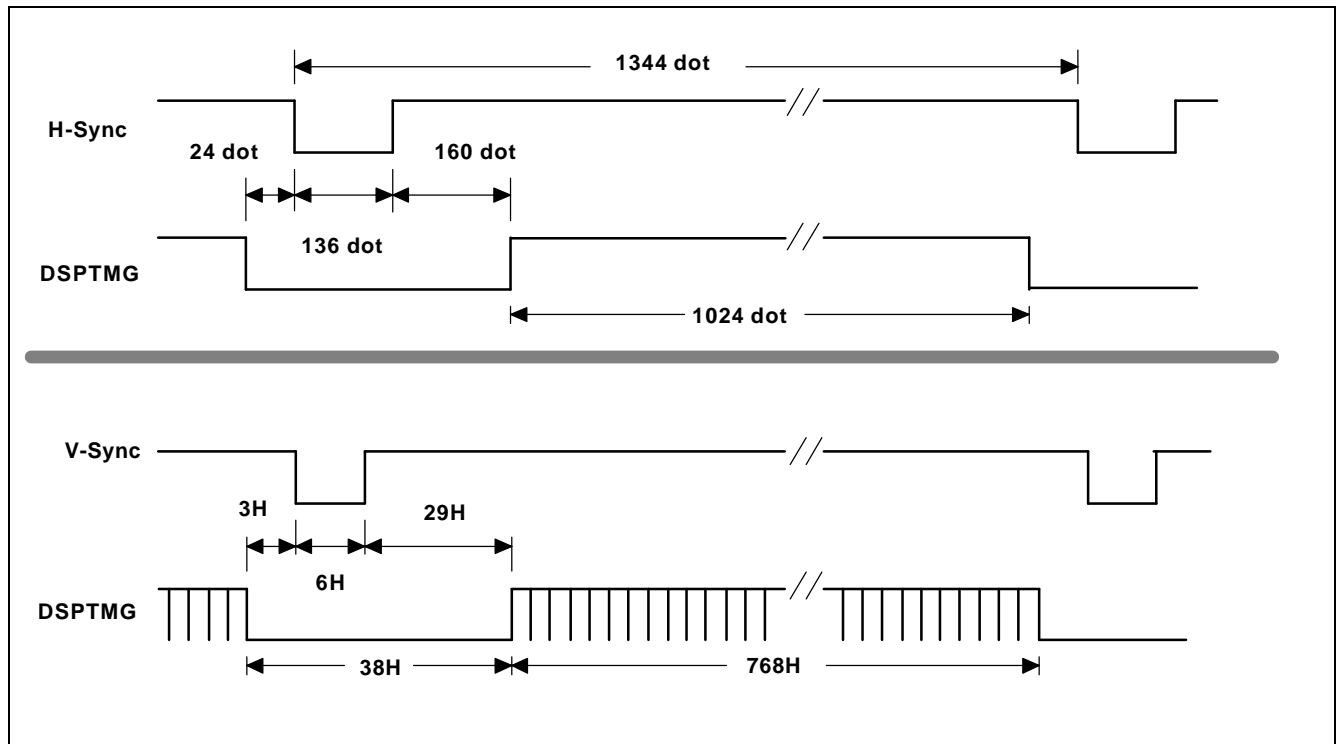
**Note1:**  $32 \leq Hsw + Hbp < 515$  [tck].

**Note2:** Vbp should be static.

**Note3:** Frame rate should not be less than 30Hz to keep reliability of the Liquid Crystal Cell. Frame rate lower than 40Hz may cause screen flickering.

If timing signal is invalid, the LCD enters "self protection mode" and the screen becomes whole black. Once the signal is back, it resumes normal operation.

## 8.2 Timing Definition



## 9.0 Power Consumption

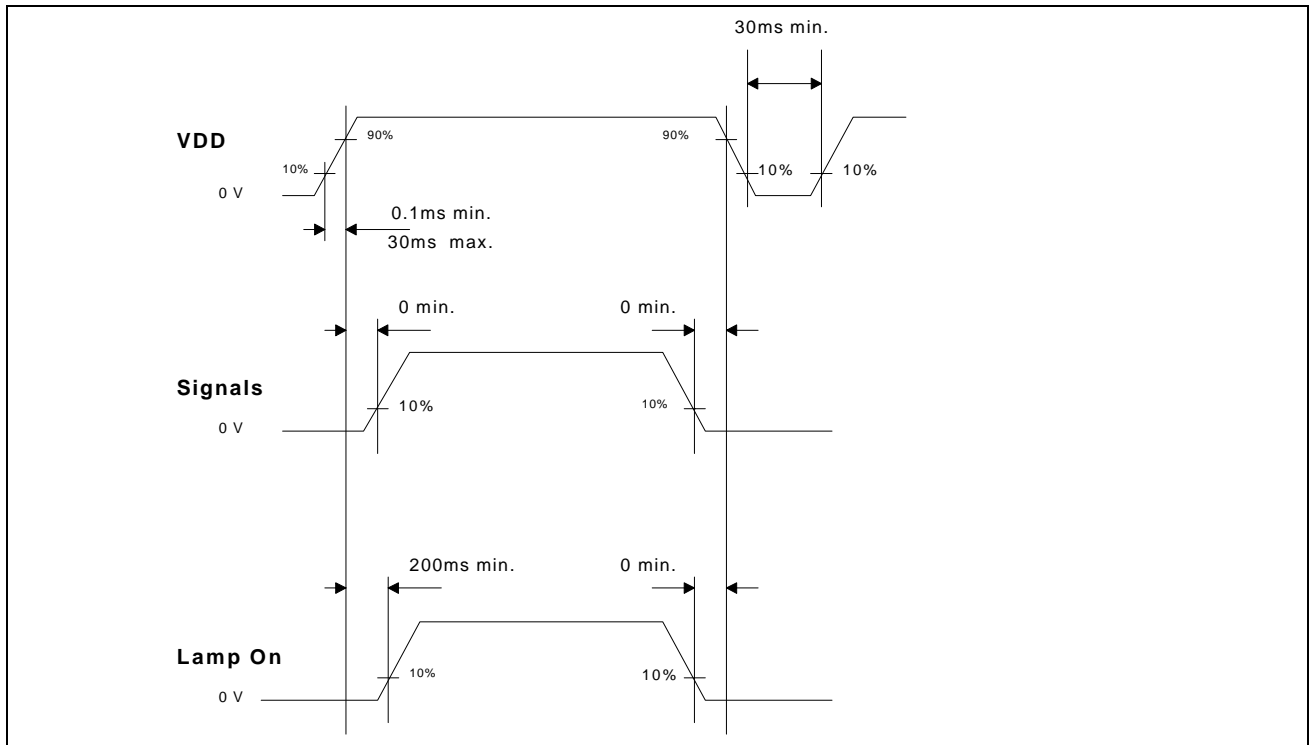
Input power specifications are as follows;

SYMBOL	PARAMETER	Min	Typ	Max	UNITS	CONDITION
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[V]	Load Capacitance 20[uF]
PDD	VDD Power			1.2	[W]	Max. Pattern, VDD=3.6[V]
PDD	VDD Power		0.7		[W]	All Black Pattern, VDD=3.3[V] Clock frequency=54MHz
IDD	VDD Current			340	[mA]	Max Pattern, VDD=3.6[V]
IDD	VDD Current		200		[mA]	All Black Pattern, VDD=3.3[V] Clock frequency=54MHz
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			100	[mVp-p]	

## 10.0 Power ON/OFF Sequence

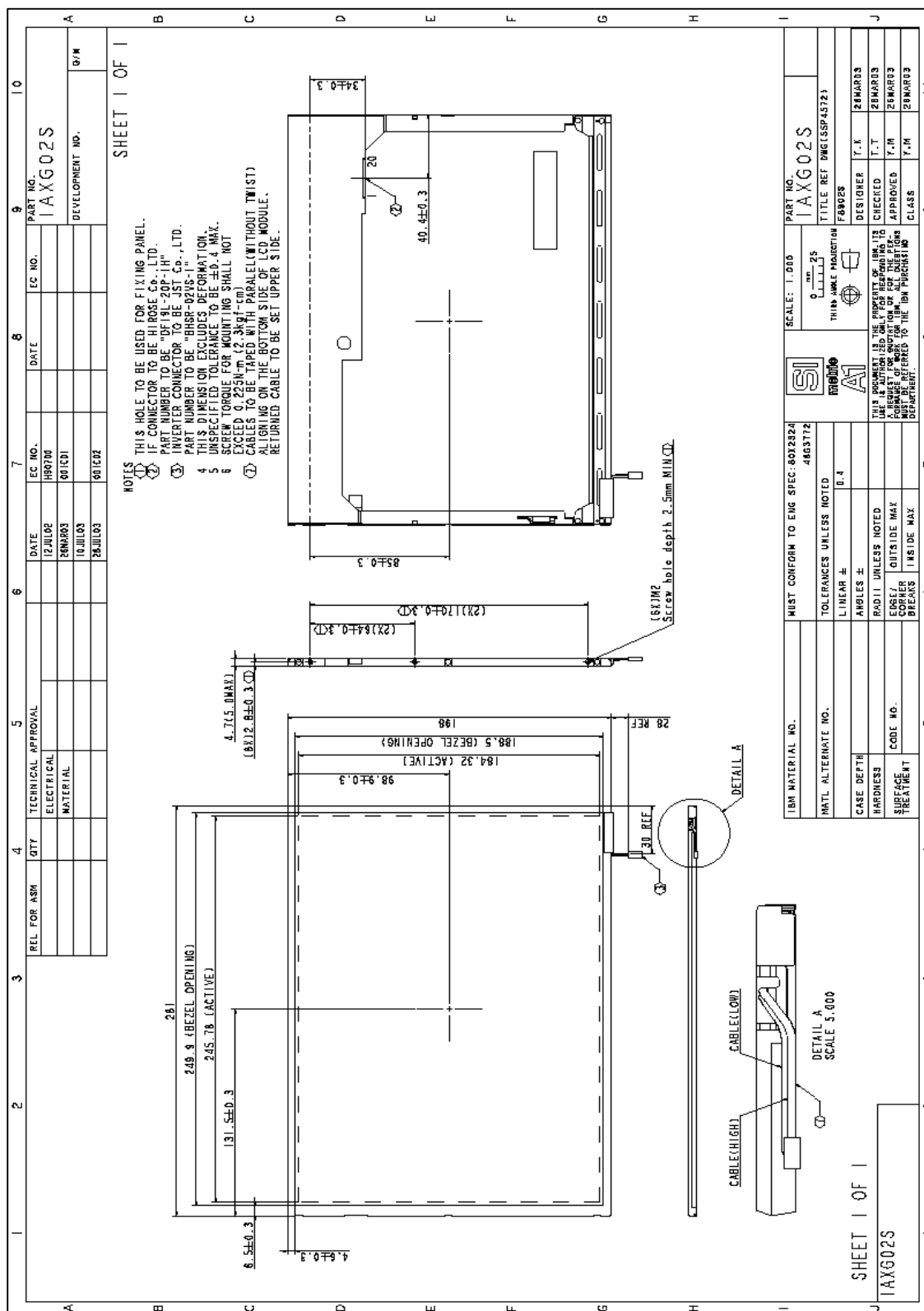
VDD power and lamp on/off sequence is as follows. Interface signals are also shown in the chart.

Signals from any system shall be Hi-Z state or low level when VDD is off.





## 11.0 Mechanical Characteristics





## **12.0 National Test Lab Requirement**

The display module is authorized to Apply the UL Recognized Mark.

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