

Engineering Specification

46.0cm(18.1") SXGA Color TFT/LCD Module
Model Name:ITSX94

Document Control Number : OEM94-08

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

Display Business Unit
International Business Machines Corporation

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ii Record of Revision

Date	Document Revision	Page	Summary
Novemver 9,1998	OEM94-01 (Preliminary)	All	First Edition for customer. Based on Draft Internal Spec. as of June 30,1998 Based on Mechanical Drawing as of Draft November 5,1998.
November 13,1998	OEM94-02 (Preliminary)	5,8	To update Response Time.
February 9,1999	OEM94-03 (Preliminary)	5 8 13 15 18 25,26	To update as follows: Weight, The explanation of Electrical Interface. Viewing Angle,Color Chromaticity,White Luminance. SELLVDS=Low ITSX94 LVDS Signal. Luminance-VDIM curve Mechanical Drawing as of EC F21750,1998.
April 23,1999	OEM94-04	4 5,8 7 11,16 24 25,26	To update as follows: To add Precautions. T.B.D items. Absolute Maximum Ratings. VcontIN Power on sequence Drawing EC F21752 Based on Internal Spec. as of EC F21752.
June 10,1999	OEM94-05	11,12 24 25,26	To correct the description. To correct Vin and VBL on Power on sequence. To add (Note 9) on Drawing EC F21752 as of May 19, 1999.
June 15,1999	OEM94-06	5,8 7 8	To update Optical rise time/fall time. To add note for Vibration and shock. To add Min. value for contrast and Maximum White Luminance.
March 10,2000	OEM94-07	5 25,26	To update Weight and Physical Size. To update Reference Drawings.
October 23,2000	OEM94-08	4 5,23 16 19 23 25 26,27	Based on Internal Spec. EC F21763 as of October 20,2000. To update Handling Precautions. To update Power Consumption. To define LVDS Timing and to add definition of Trxd, Trxs and Trsc. To change the minimun value for Setup Time/Hold Time loosly. To update Luminance - VDIM Curve for new Inverter reason. To update Interface Timing Definition for visibility only. To update power ON/OFF Sequence. To update Reference Drawings.

1.0 Handling Precautions

- Damage to the panel or the panel electronics may result from any deviation from the recommended power on/off sequencing. The panel should not be hot plugged. Refer to the Power On/Off Sequence section in this Specification.
- Handle the panel with care. The LCD panel and CCFL (Cold Cathode Fluorescent Lamp)s are made of glass and may crack or break if dropped or subjected to excessive force.
- The CCFLs contain a small amount of Mercury so should not be disposed of to landfill. Dispose of as required by local ordinances or regulations.
- The panel may be damaged by the application of twisting or bending forces to the module assembly. Care should be taken in the design of the monitor housing and the assembly procedure to prevent stress damage to the panel especially the lamp cable and the lamp connector..
- Use standard earthing/grounding procedures to prevent damage to the CMOS LSI while handling the module.
- Use earthing/grounding procedures, an ionic shower, or similar to prevent static damage while removing the protective front sheet.
- The front polarizer can be easily damaged. Take care not to scratch the front surface with any hard or abrasive material. Dust, finger marks, grease etc. can be removed with a soft damp cloth (a small amount of mild detergent can be used on the damp cloth). Do not apply water or detergent directly to the front surface as this may cause staining or damage the electronic components.
- Never use any solvent on the front polarizer or module as this may cause permanent damage.
- Do not open or modify the module assembly.
- Continuous operation of the panel with the same screen content may result in some image sticking. Over 10 hours operation with the same content is not recommended.

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2.0 General Description

This specification applies to the 46.0cm(18.1") Color TFT/LCD Module 'ITSX94'.

This module is designed for a LCD monitor style display unit. This module includes inverter card.

The screen format and electrical interface are intended to support the VESA SXGA (1280(H) x 1024(V) at 60Hz) screen.

Support color is native 16M colors (RGB 8-bit data driver).

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

2.1 Characteristics

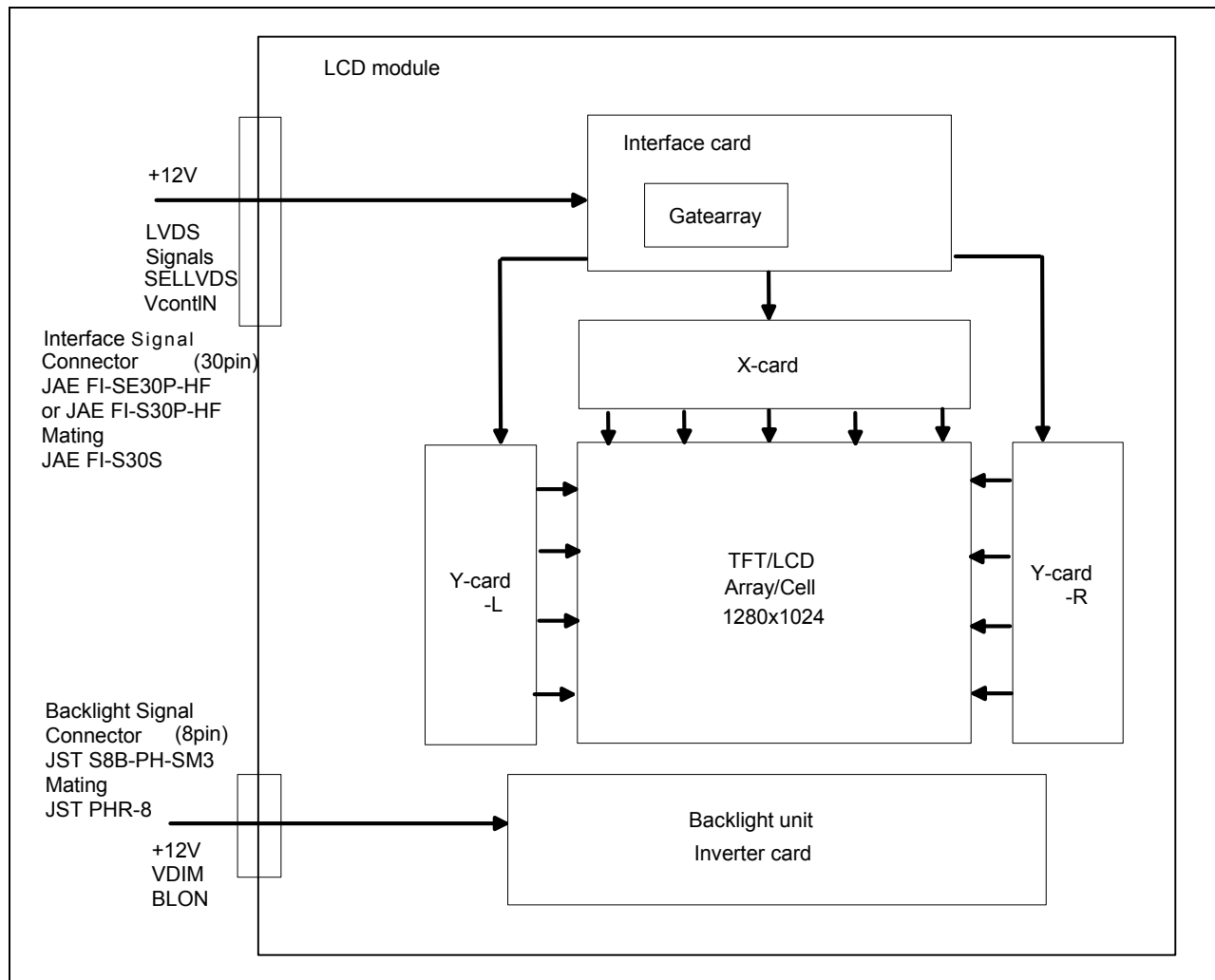
The following items are characteristics summary on the table under 25 degree C condition:

CHARACTERISTICS ITEMS	SPECIFICATIONS
Screen Diagonal [cm]	46.0 (18.1")
Pixels H x V	1280(x3) x 1024
Active Area [mm]	359.0(H) x 287.2(V)
Pixel Pitch [mm]	0.2805(per one triad) x 0.2805
Pixel Arrangement	R,G,B Vertical Stripe
Weight [grams]	3,000 typ.
Physical Size [mm]	389.0(W) x 317.2(H) x 35.0(D) Max.
Display Mode	Normally Black
Support Color	16M (RGB 8-bit data)
White Luminance [cd/m ²]	235 Typ
Contrast Ratio	300 : 1 Typ.
Optical Rise Time/Fall Time [msec]	Respective : 25 Typ (each) Note Rise Time + Fall Time : 50 Typ (total)
Input Voltage [V]	+12 +/- 5%
Power Consumption [W]	44 max , 40 Typ.
Electrical Interface	LVDS Dual (Even/Odd R/G/B Data(8bit), 3sync signals, Clock)
Temperature Range [degree C]	
Operating	0 to +50
Storage (Shipping)	-20 to +60

Note : Luminance : Rise / Fall Time: Respective 10% -> 90%, 90% -> 10%

2.2 Functional Block Diagram

The following diagram shows the functional block of this 46.0cm(18.1") Color TFT/LCD Module.



3.0 Absolute Maximum Ratings

Absolute maximum ratings of the module is as follows :

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	Vin	-0.3	+13.2	V	
Backlight Voltage	VBL	-0.3	+13.2	V	
Select LVDS data order	SELLVDS	-0.3	3.3	V	
Contrast control	VcontIN	-0.3	3.3	V	
Brightness control	VDIM	-0.3	5.3	V	
Backlight on signal	BLON	-0.3	+5.3	V	
Operating Temperature	TOP	0	+50	deg.C	Note 1
Operating Humidity	HOP	8	80	%RH	Note 1
Storage Temperature	TST	-20	+60	deg.C	Note 1
Storage Humidity	HST	5	95	%RH	Note 1
Vibration			1.5 10-200	G Hz	Note 2
Shock			35 20	G ms	Note 2 Half sine wave

Note 1 : Maximum Wet-Bulb should be 39 degree C and No condensation.

Note 2 : Vibration Specification

- Sign Vibration:10-200-10Hz, 1.5G, 0.29 Oct/min, 30 min, X, Y, A Axis, Each One Time.

Shock Specification

- Half sine wave:35G 20msec. -X+/-, -Y+/-, -Z+/- (Total 6 directions), Each two times Shock.

4.0 Optical Characteristics

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

Item	Conditions	Specification		
		Min.	Typ.	Note
Viewing Angle (Degrees)	Horizontal (Right)	60	80	-
	K \geq 10 (Left)	60	80	-
K:Contrast Ratio	Vertical (Upper)	60	80	-
	K \geq 10 (Lower)	60	80	-
Contrast ratio		200	300	-
Response Time (ms)	Rising(10%→90%)	-	25	-
	Falling(90%→10%)	-	25	-
Color Chromaticity (CIE)	Red x	-	0.633	+0.040
	Red y	-	0.345	+0.030
	Green x	-	0.287	+0.030
	Green y	-	0.616	+0.030
	Blue x	-	0.141	+0.030
	Blue y	-	0.090	+0.040
	White x	-	0.310	+0.030
	White y		0.346	+0.030
Maximum White Luminance (cd/m ²)	VDIM=0V Note	200	235	-
Minimum White Luminance (%)	(Maximum White Luminance = 100%) VDIM=4V	-	10	20 Max

Note:Measure center of the screen.

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	JAE
Type / Part Number	FI-SE30P-HF or FI-S30P-HF
Mating Housing/Part Number	FI-S30S
Mating Contact/Part Number	FI-C3-A1

Connector Name / Designation	For Backlight Connector on Inverter card
Manufacturer	JST
Type / Part Number	S8B-PH-SM3
Mating Type / Part Number	PHR-8

5.2 Interface Signal Connector

Pin #	Signal Name	Pin #	Signal Name
1	Vin(+12V)	2	Vin(+12V)
3	Vin(+12V)	4	VinRTN(GND)
5	VinRTN(GND)	6	VinRTN(GND)
7	SELLVDS	8	VcontIN
9	DGND	10	RxOIN3+
11	RxOIN3-	12	RxOCLKIN+
13	RxOCLKIN-	14	RxOIN2+
15	RxOIN2-	16	RxOIN1+
17	RxOIN1-	18	RxOIN0+
19	RxOIN0-	20	RxEIN3+
21	RxEIN3-	22	RxECLKIN+
23	RxECLKIN-	24	RxEIN2+
25	RxEIN2-	26	RxEIN1+
27	RxEIN1-	28	RxEIN0+
29	RxEIN0-	30	LVDSGND

5.3 Interface Signal Description

The module uses a pair of LVDS receiver SN75LVDS82(Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible.

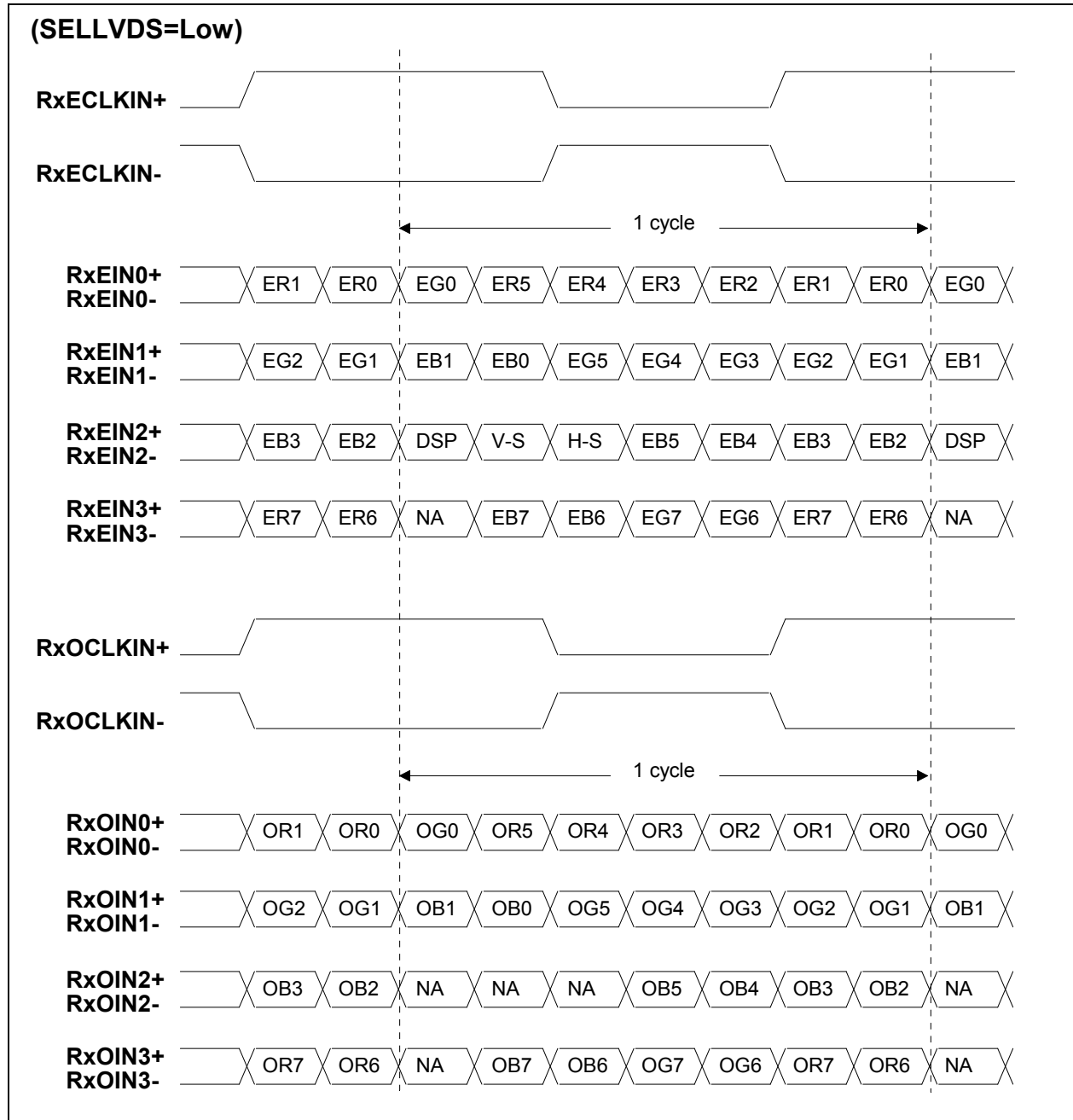
The first LVDS port (RxExxx) transmits even pixels while the second LVDS port (RxOxxx) transmits odd pixels.

PIN #	SIGNAL NAME	Description
1	Vin	+12.0V Power Supply
2	Vin	+12.0V Power Supply
3	Vin	+12.0V Power Supply
4	VinRTN	Ground for Vin line
5	VinRTN	Ground for Vin line
6	VinRTN	Ground for Vin line
7	SELLVDS	Select LVDS data order. See the following figure.
8	VcontIN	Contrast signal voltage input (0-3V). Need to input stable voltage. 1.5V is the center of the design point. The Gamma curve of the gray level(Level 1 to Level 254)will be bent towards, 0V:white side 3V:black side The maximum white(Level 255)and black(Level 0) luminances will not change.
9	DGND	Digital Ground for VcontIN
10	RxOIN3+	Positive LVDS differential data input (Odd data)
11	RxOIN3-	Negative LVDS differential data input (Odd data)
12	RxOCLKIN+	Positive LVDS differential clock input (Odd Clock)
13	RxOCLKIN-	Negative LVDS differential clock input (Odd Clock)
14	RxOIN2+	Positive LVDS differential data input (Odd data)
15	RxOIN2-	Negative LVDS differential data input (Odd data)
16	RxOIN1+	Positive LVDS differential data input (Odd data)
17	RxOIN1-	Negative LVDS differential data input (Odd data)
18	RxOIN0+	Positive LVDS differential data input (Odd data)
19	RxOIN0-	Negative LVDS differential data input (Odd data)
20	RxEIN3+	Positive LVDS differential data input (Even data)
21	RxEIN3-	Negative LVDS differential data input (Even data)
22	RxECLKIN+	Positive LVDS differential clock input (Even Clock)
23	RxECLKIN-	Negative LVDS differential clock input (Even Clock)
24	RxEIN2+	Positive LVDS differential data input (Even data,H-Sync,V-Sync,DSPTMG)

25	RxEIN2-	Negative LVDS differential data input (Even data,H-Sync,V-Sync,DSPTMG)
26	RxEIN1+	Positive LVDS differential data input (Even data)
27	RxEIN1-	Negative LVDS differential data input (Even data)
28	RxEIN0+	Positive LVDS differential data input (Even data)
29	RxEIN0-	Negative LVDS differential data input (Even data)
30	LVDSGEN	Ground for LVDS clock/data signals

Note: Input signals of odd and even clock shall be the same timing.

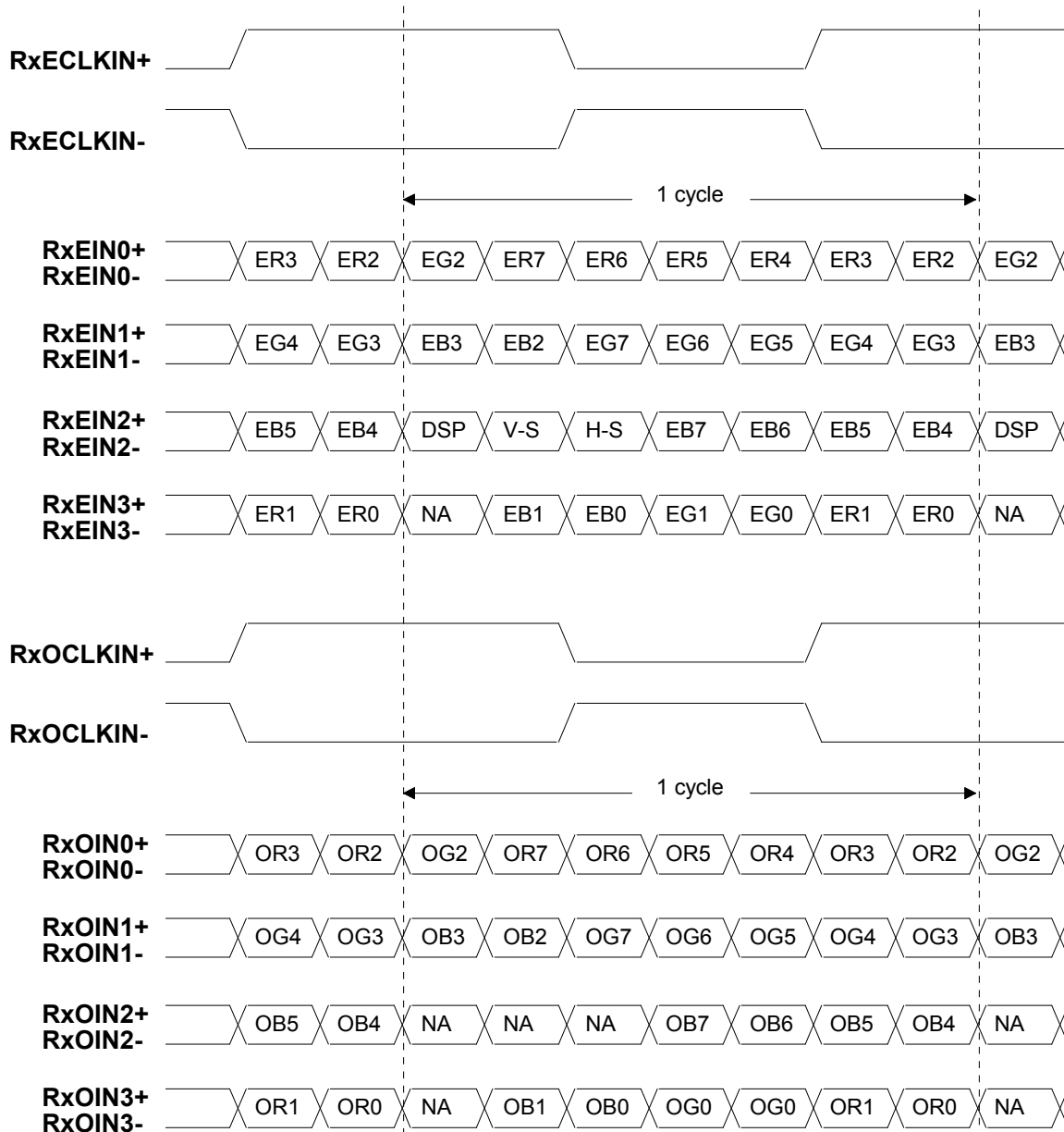
The interface card has a 100ohm resistor between positive and negative lines of each LVDS signal input on the internal circuit.



Note: R/G/B data 7:MSB, R/G/B data 0:LSB



(SELLVDS=High)



Note: R/G/B data 7:MSB, R/G/B data 0:LSB

The following is LVDS Signal description.

LVDS DATA NAME	Description
DSP	Display Timing When the signal is high, the pixel data shall be valid to be displayed.
V-S	Vertical Sync Both Positive and negative polarity are acceptable.
H-S	Horizontal Sync Both Positive and negative polarity are acceptable.

TI LVDS X'mitter (SN75LVDS83) Signal name	F8594 LVDS Signal (SELLVDS=Low)	F8594 LVDS Signal (SELLVDS=High)
D0	Red0	Red2
D1	Red1	Red3
D2	Red2	Red4
D3	Red3	Red5
D4	Red4	Red6
D5	Red7	Red1
D6	Red5	Red7
D7	Green0	Green2
D8	Green1	Green3
D9	Green2	Green4
D10	Green6	Green0
D11	Green7	Green1
D12	Green3	Green5
D13	Green4	Green6
D14	Green5	Green7
D15	Blue0	Blue2
D16	Blue6	Blue0
D17	Blue7	Blue1
D18	Blue1	Blue3
D19	Blue2	Blue4
D20	Blue3	Blue5
D21	Blue4	Blue6
D22	Blue5	Blue7
D23	NA	NA
D24	H Sync	H Sync
D25	V Sync	V Sync
D26	Disp Timing	Disp Timing
D27	Red6	Red0

Note:

SELLVDS: Pin#7 of Signal connector

Red0: LSB, Red7: MSB

5.4 Interface Signal Electrical Characteristics

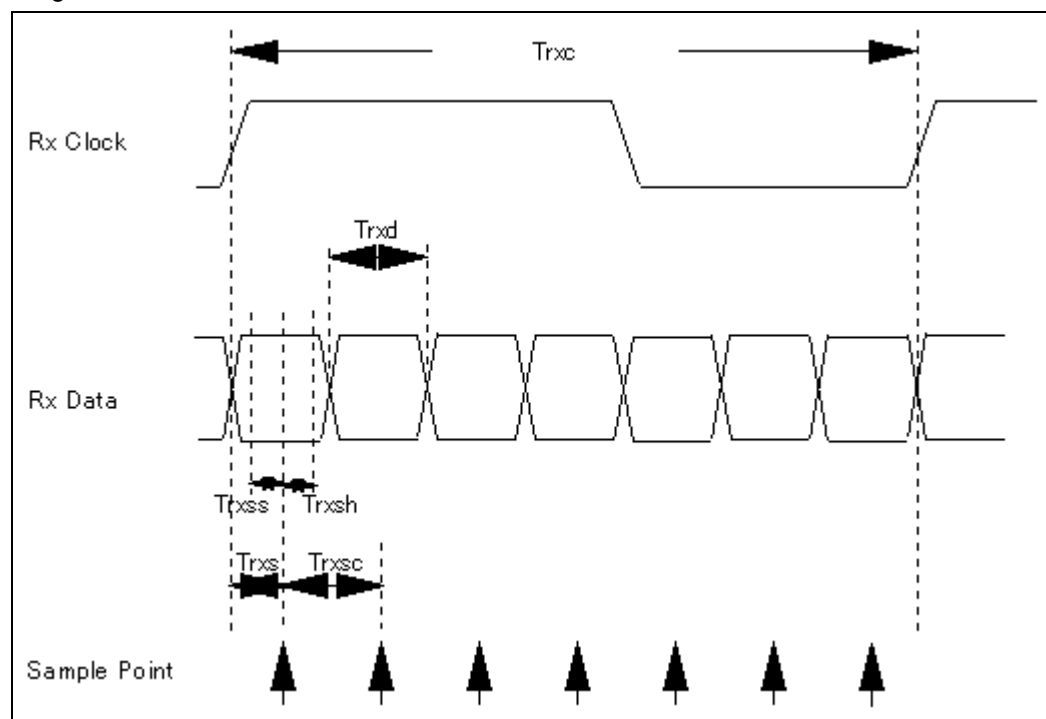
Input signals shall be low or Hi-Z state when Vin is off.

It is recommended to refer the specifications of SN75LVDS82DGG(Texas Instruments) in detail.

Signal electrical characteristics are as follows;

Parameter	Condition	Min	Max	unit
Vth	Differential Input High Voltage (Vcm=+1.2V)		100	mV
Vtl	Differential Input High Voltage (Vcm=+1.2V)	-100		mV

LVDS Timing



LVDS Macro AC characteristics.

Parameter	Symbol	Min	Typ	Max	Unit
LVDS Clock Cycle	Trxc				[ns]
LVDS Data Cycle	Trxd		Trxc/7		[ns]
Sample Data Setup Time (Trxc=Typ.)	Trxss	600			[ps]
Sample Data Hold Time (Trxc=Typ.)	Trxsh	600			[ps]
Data Sample Time	Trxs		Trxc/14		[ns]
Data Sample Cycle	Trxsc		Trxc/7		[ns]



Name	Description	Min	Typ	Max	Unit	Note
SELLVDS	Hight voltage	2	3	3.3	V	
	Low voltage	-0.1	0	0.7	V	
	Current	-1	-	1	mA	
VcontlN	Input Voltage range	0	1.5	3	V	0V:towards white side 3V:towards black side
	Current	-1	-	1	mA	

5.5 Backlight Signal Connector

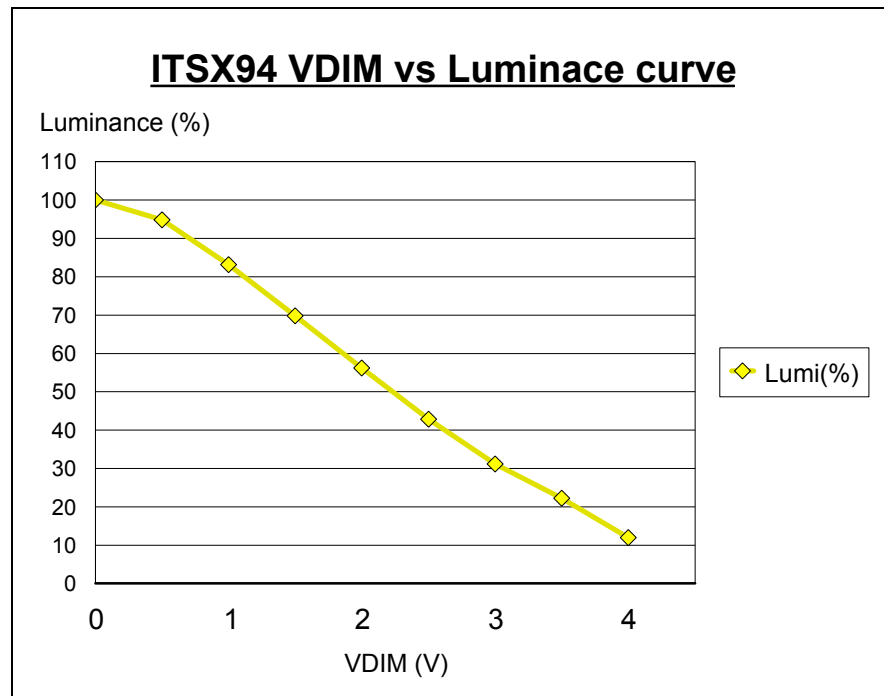
For Backlight Signal connector on Inverter card

PIN #	SIGNAL NAME	Description
1	VBL	+12.0V Power Supply for backlight
2	VBL	+12.0V Power Supply for backlight
3	VBL	+12.0V Power Supply for backliht
4	RTN	Ground for VBL line, VDIM and BLON
5	RTN	Ground for VBL line, VDIM and BLON
6	RTN	Ground for VBL line, VDIM and BLON
7	VDIM	Brightness control voltage input(0-4V), (0V:brightness MAX, 4V:brightness MIN)
8	BLON	backliht on/off signal(Hi:backlight ON, Low:backlight OFF) TTL level

5.6 Backlight Signal Electrical Characteristics

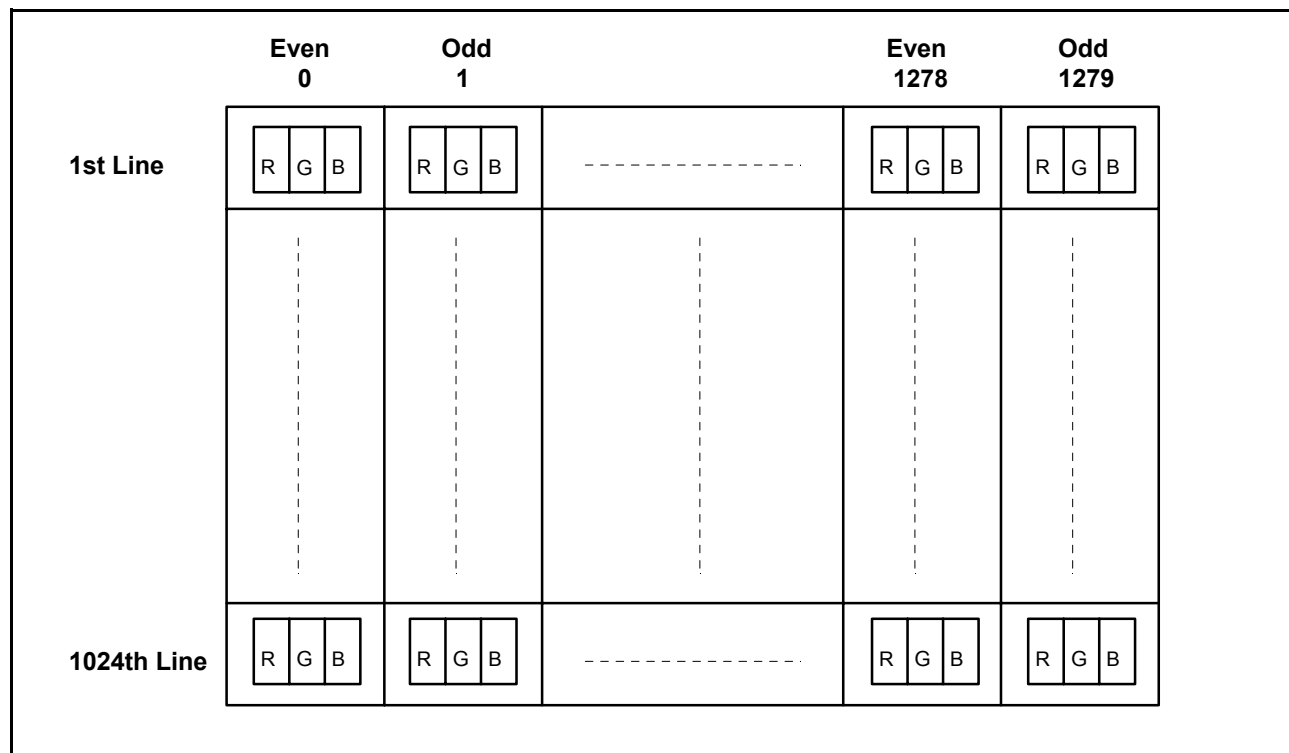
Name	Description	Min	Typ	Max	Unit	Note
BLON	Hight voltage	2	5	5.25	V	
	Low voltage	-0.1	0	0.8	V	
	Current	-1	-	1	mA	
VDIM	Input Voltage Range	0	-	4	V	0V: Brightness Max. 4V: Brightness Min.
	Current	-1	-	1	mA	

The following chart is the Brightness control voltage versus the luminance for your reference.



6.0 Pixel format image

Following figure shows the relationship of the input signals and LCD pixel format image. Odd and even pair of RGB data are sampled at a time.



7.0 Interface Timings

Basically, interface timings described here is not actual input timing of LCD module but output timing of SN75LVDS82DGG(Texas Instruments) or equivalent.

7.1 Timing Characteristics

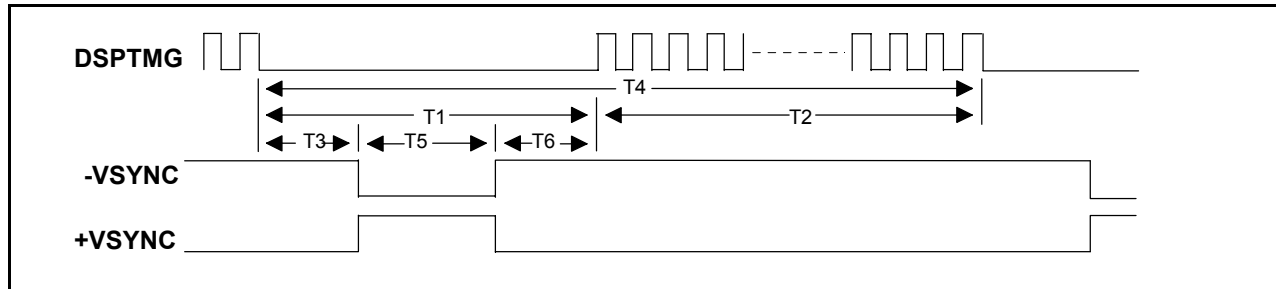
Signal	Item	Symbol	MIN.	TYP.	MAX.	Blair-SX (reference)	Unit
DTCLK	Freq.	Fdck	50	54	56.8	50	MHz
DTCLK	Cycle	Tck	17.6	18.5	20	20	ns
+V-Sync	Frame Rate	1/Tv	56.25	60.02	61	57.24	Hz
+V-Sync	Cycle	Tv	16.39	16.66	17.78	17.47	ms
+V-Sync	Cycle	Tv	1035	1066	2047	1035	lines
+V-Sync	active level	Tva	3	3		3	lines
+V-Sync	V-back porch	Tvb	7	38	63	7	lines
+V-Sync	V-front porch	Tvf	1	1		1	lines
+DSPTMG	V-Line	m	-	1024	-	1024	lines
+H-Sync	Scan Rate	1/Th	-	63.98	-	59.24	KHz
+H-Sync	Cycle	Th	844	844	1023	844	Tck
+H-Sync	active level	Tha(*1)	4	56		56	Tck
+H-Sync	Back porch	Thb(*1)	4	124		124	Tck
+H-Sync	Front porch	Thf	4	24		24	Tck
+DSPTMG	Display Pixels	n	-	640	-	640	Tck

Note: Typical value is refer to VESA STANDARD.

(*1): Tha+Thb should be less than 1024 Tck.

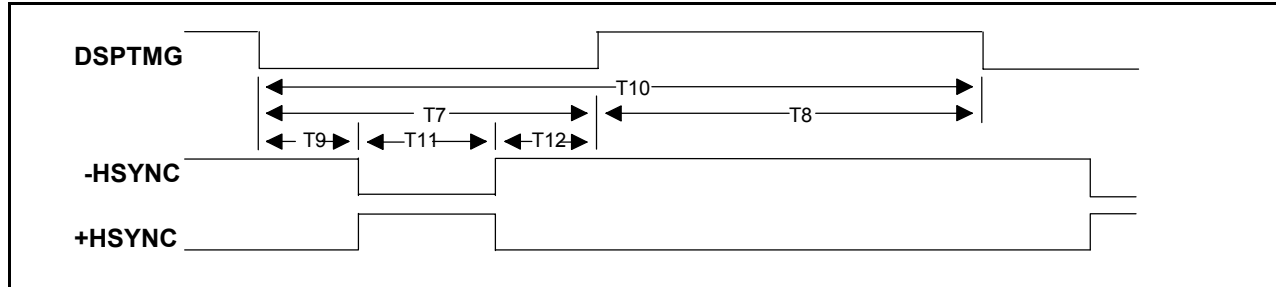
7.2 Timing Definition

Vertical Timing



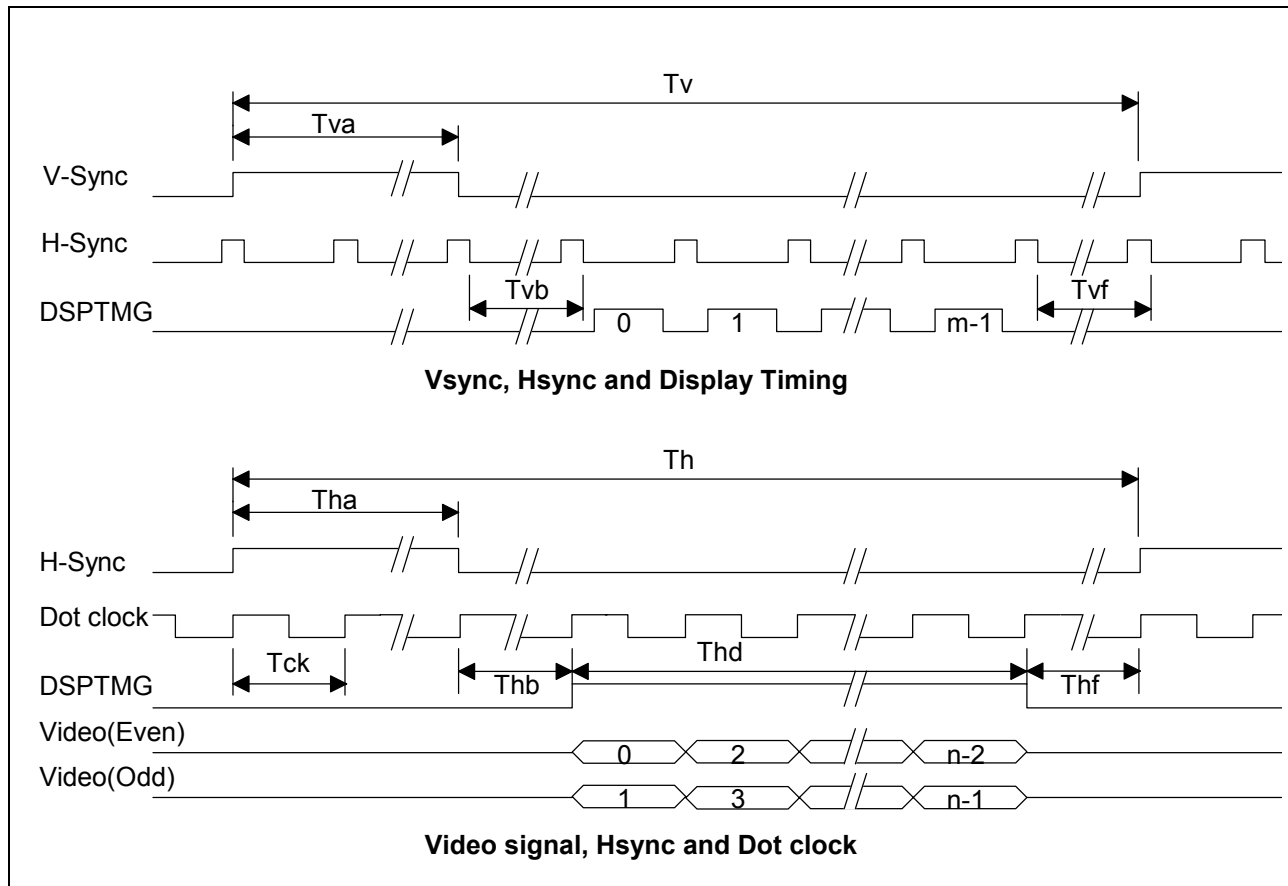
Support mode	T1 Vertical Blanking	T2 Active Field	T3 VSYNC Front Porch	T4 Frame Time	T5 VSYNC Width	T6 VSYNC Back Porch
1280 x 1024 at 60Hz (VESA STANDARD) (H line rate : 15.6 us)	0.656 ms (42 lines)	16.005 ms (1024 lines)	0.016 ms (1 line)	16.661 ms (1066 lines)	0.047 ms (3 lines)	0.594 ms (38 lines)

Horizontal Timing



Support mode	T7 Horizontal Blanking	T8 Active Field	T9 HSYNC Front Porch	T10 H line Time	T11 HSYNC Width	T12 HSYNC Back Porch
1280 x 1024 (VESA STANDARD) (Dotclock : 108.000 MHz)	3.778 us (408 dots)	11.852 us (1280 dots)	0.444 us (48 dots)	15.630 us (1688 dots)	1.037 us (112 dots)	2.296 us (248 dots)

Interface Timing Definition





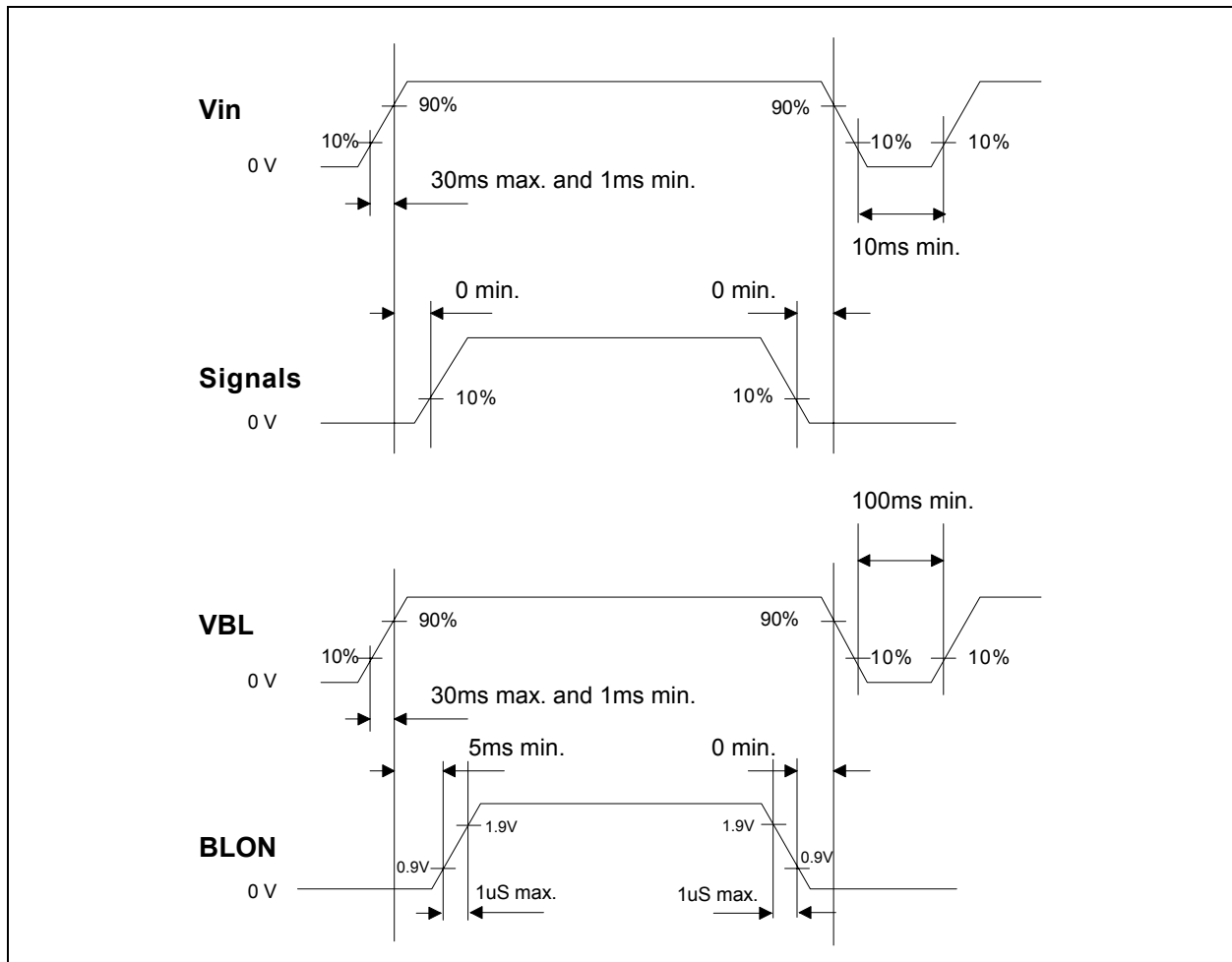
8.0 Power Consumption

Input power specifications are as follows;

SYMBOL	PARAMETER	Min	Typ	Max	UNITS	CONDITION
Vin	Logic/LCD Drive Voltage	11.4	12	12.6	V	
Iin	Vin Current		670	840	mA	Vin=12V
Pin	Vin Power		8	10	W	Vin=12V All White Pattern
Vin rp	Allowable Logic/LCD Drive Ripple Voltage			100	mVp-p	
Vin ns	Allowable Logic/LCD Drive Ripple Noise			100	mVp-p	
VBL	Backlight power Voltage	11.4	12	12.6	V	
PBL	Backlight Power consumption		30	36	W	Brightness=max

9.0 Power ON/OFF Sequence

Vin and VBL 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 Vin and VBL are off.



10.0 Mechanical Characteristics

