LCD Module

Product Specification

☐ : **APPROVAL FOR SPECIFICATION**

For Customer：_____ ☐ : **APPROVAL FOR SAMPLE**

Module No.： **TST121TC-XL01**

For Customer's Acceptance ：

Approved by	Comment

Team Source Display ：

Presented by	Reviewed by	Organized by

RECORD OF REVISION

Rev	Issued Date	Description	Editor
1.0	2011-09-30	Preliminary Release	StepheHunk

1. OUTLINE

STRUCTURE AND PRINCIPLE

TST121TC-XL01module is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a acklight. The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

APPLICATIONS
- Monitor for industrial display

FEATURES
- a-Si TFT active matrix
- LVDS interface
- R.G.B input 8bit, 16.2 millions colors
- Resolution SVGA (800× 600 pixels)
- Wide viewing angle 70°/70° (L/R); 50°/60° (U/D)
- Contrast ratio 600 :1
- Module size 279.0 (H) ×209.0 (V) ×11.0 (D) mm
- Fast response time (Ton+ Toff= 35 ms）
- Color gamut (55%)
- Edge light type backlight (2 CCFL Lamps)
- Inverter less
- RoHS compliance TCO 5.0 compliance

2. GENERAL SPECIFICATIONS

Display area	246.0 (H) × 184.5 (V) mm (typ.)
Diagonal size of display	30.7 cm (12.1 inches)
Drive system	a-Si TFT active matrix
Display color	16.2 M colors
Pixel	800 (H) × 600(V) pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.3075 (H) × 0.3075 (V) mm
Module size	279.0 (H) ×209.0 (V) ×11.0 (D) mm
Weight	TBD
Contrast ratio	600 :1 (typ.)
Viewing angle	140°/ 110° (typ.)
Color gamut	55 % (typ.)
Response time	35 ms (typ.)
Luminance	400 cd/m^2 (typ.)
Transmissive Mode	Normally White
Surface Treatment	Anti Glare
Signal system	LVDS 1port
Power supply voltage	LCD panel signal processing board: 5.0V
Backlight	2 CCFL
Power consumption	TBD

3. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	Power voltage	VDD	-0.3 ~ +6.0	V	Ta = 25°C
	Lamp voltage	V_{BLH}	770 ~ 930	Vrms	Ta = 25°C
Input voltage for signals		Vi	-0.3 ~ +3.3	V	Ta = 25°C
Lamp current		I_{BL}	3.0~6.5	mArms	Ta = 25°C For each lamp
Lamp Oscillation frequency		FO	40~60	kHz	Ta = 25°C
Storage temperature		Tst	-30 ~ +80	°C	Note 3
Operating temperature		Top	-20 ~ +70	°C	Note 3, 4
Absolute humidity		AH	≤ 70	g/m^3	Ta > 50°C
Operating altitude		-	≤ 4,850	m	-20°C≤ Ta≤ 70°C
Storage altitude		-	≤ 13,600	m	-30°C≤ Ta≤ 80°C

Note1: Display signals are DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, and CKB+/-.

Note2: Function signal is MSL.

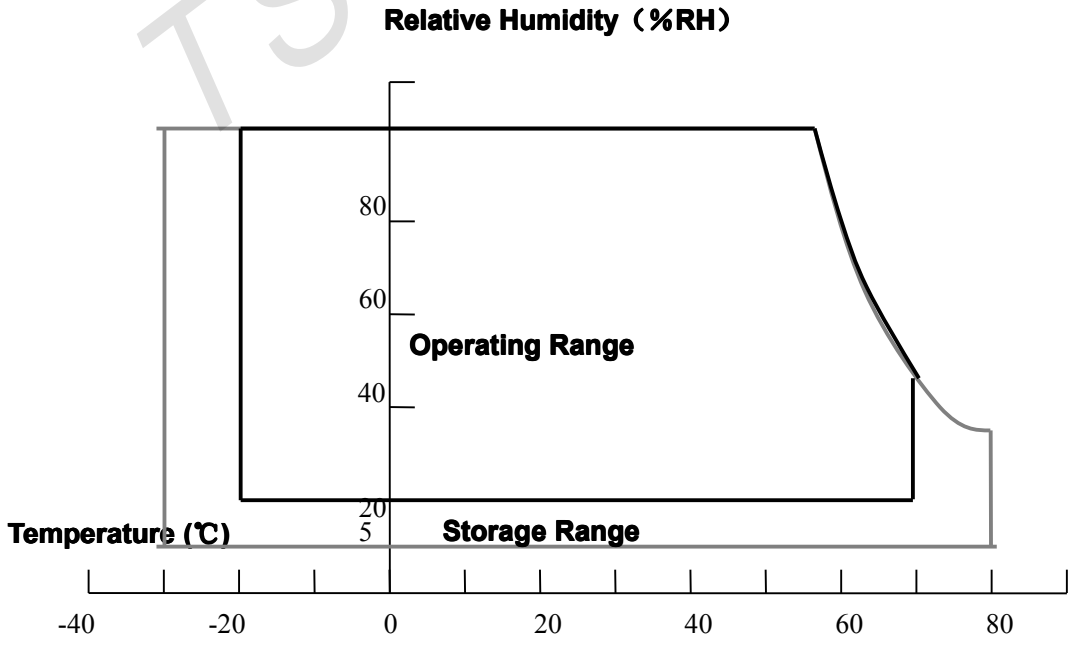
Note3: Temperature and relative humidity range is shown in the figure below.

(a) 90%RH Max. (Ta≤ 40°C)

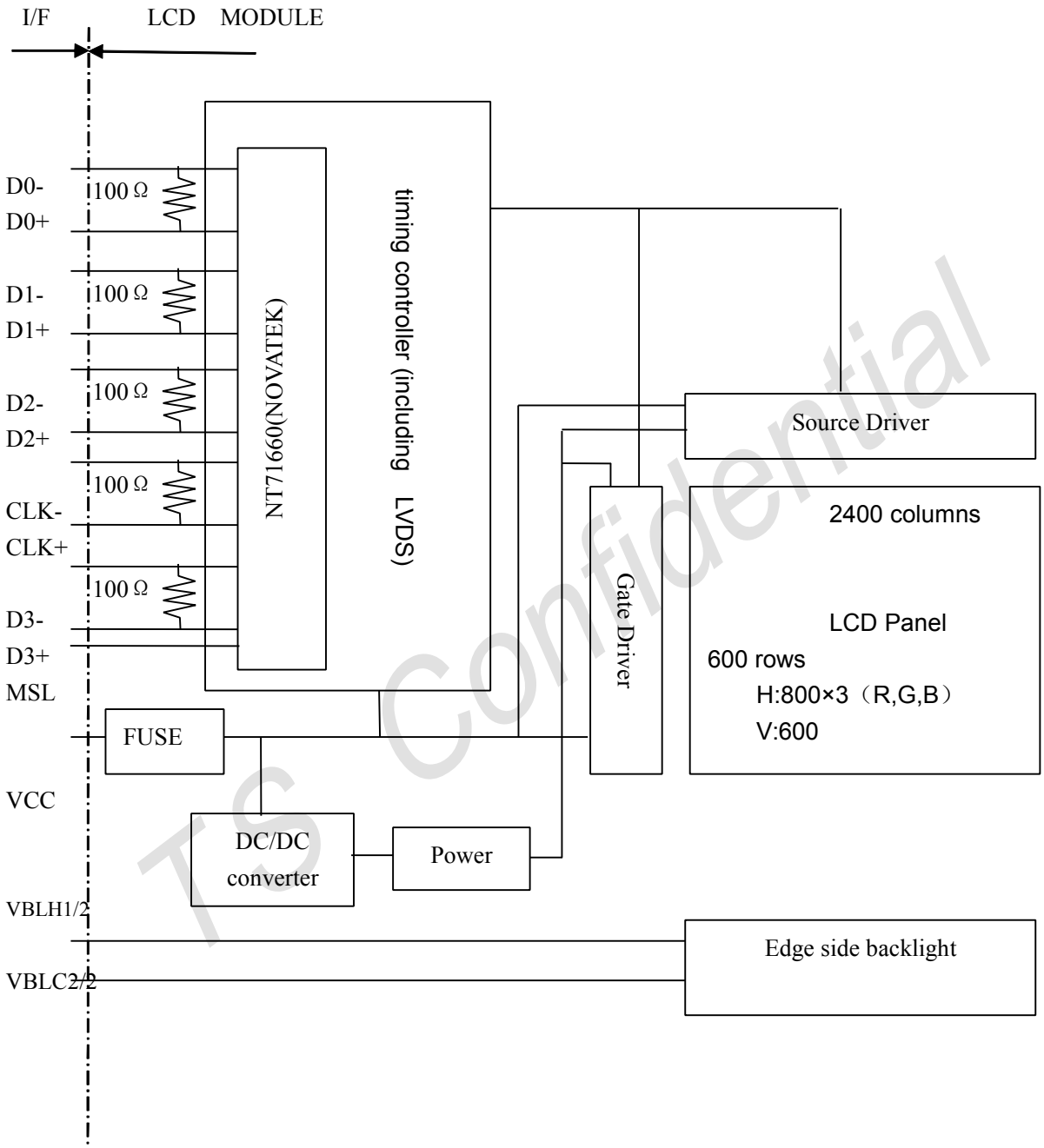
(b) Wet-bulb temperature should be39°C Max. (Ta> 40°C)

(c) No condensation.

Note4: The temperature of panel display surface area should be 0°C Min and 60°C Max.



4. BLOCK DIAGRAM



Note: System ground (GND), FG (Frame ground) in the product should be connected together in customer equipment.

5. MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	279.0± 0.5 (W) × 209.0 ± 0.5 (H) × 11.0 (D)	mm
Display area	246.0(H) × 184.5(V) mm (typ.), [30.75 cm (12.1 inches)]	mm
Weight	TBD	g

6. ELECTRICAL CHARACTERISTICS

6.1 DRIVING FOR LCD

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	3.0	3.3	3.6	V	-
Power supply current		IDD	-	-	325 Note 1	mA	at VDD = 3.3V
Permissible ripple voltage		VRP	-	-	100	mV	VDD
Differential input voltage		| Vid |	250		450	mV	
Differential input threshold voltage for LVDS receiver	Low	VTL	-100	-	-	mV	VCM = 1.25V Note2
	High	VTH	-	-	100	mV	
Input voltage width for LVDS receiver		Vi	0	-	2.4	V	-
Terminating resistor		RT	-	100	-	Ω	-
Rush current		I_{rush}	-	-	1.5	A	Note3

Note 1: All black pattern

Note 2: Common mode voltage for LVDS receiver

Note 3: Measurement Conditions:

6.2 DRIVING FOR BACKLIGHT

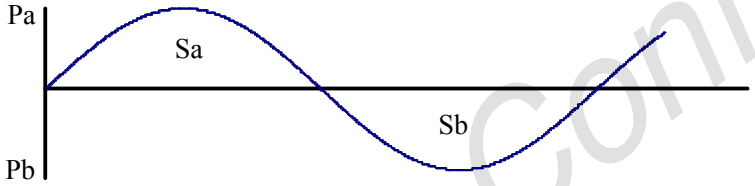
(Ta=25°C) Note1

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp voltage (for reference)	V_{BLH}	-	770	-	Vrms	For each lamp
Lamp current	I_{BL}	-	6.0	-	mArms	at L = 400cd/ m2
Lamp starting voltage Note1	VS	-	-	1120	Vrms	Ta = 0°C Note2 Note3
		-	-	930		Ta =25°C Note2 Note3
Lamp operating lifetime	Hr	-	50000	-	Hour	Note5
Oscillation frequency	FO	40	55	60	kHz	Note4

Note1: The backlight of this product is made up of 2 lamps. The specification above is only for one lamp.

Note2: The voltage timing cycle of each lamp should be set as the same phase. [Vs] and [VBLH] is the voltage between the high port and low port, the value is the characteristic of lamp. The starting voltage of inverter should be higher than the value. The possibility of not lighting exists by the lower voltage, so the suitable voltage should considered by the test.

Note3: The asymmetric ratio of working waveform for lamps (Lamp voltage peak ratio, Lamp current peak ratio and waveform area ratio) should be less than 5% (See the following figure). If the waveform is asymmetric, DC (Direct current) element applies into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal).



$|Pa - Pb| / Pb \times 100 \leqslant 5\%$
$|Sa - Sb| / Sb \times 100 \leqslant 5\%$

Pa: Supply voltage/current peak for positive, Pb: Supply voltage/current peak for negative
Sa: Waveform space for positive part, Sb: Waveform space for negative part

Note4: In case “FO” is not the recommended value, beat noise may display on the screen, because of interference between “FO” and “1/th”. Recommended value of “FO” is as following.

$FO = 1/4 \times 1/th \times (2n-1)$

Th: Horizontal signal period

n: Natural number (1, 2, 3 ……)

Note5: Lamp operating lifetime is mean time to half-luminance. In case the product works under room temperature environment.

7. CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

7.1 LVDS

CN1: MSB240420HE (Produced by STM) or equivalent.

Pin	Name	Description
1	VCC	3.3V Power Supply
2	VCC	3.3V Power Supply
3	GND	Ground
4	6-8Bit SEL	Select 6 or 8 Bits LVDS Input (VCC:8Bits ; GND/NC: 6Bits)
5	RIN0-	Negative(-) LVDS differential data input
6	RIN0+	Positive(+) LVDS differential data input
7	GND	Ground
8	RIN1-	Negative(-) LVDS differential data input
9	RIN1+	Positive(+) LVDS differential data input
10	GND	Ground
11	RIN2-	Negative(-) LVDS differential data input
12	RIN2+	Positive(+) LVDS differential data input
13	GND	Ground
14	CLKIN-	Clock Signal(-)
15	CLKIN+	Clock Signal(+)
16	GND	Ground
17	RIN3-	Negative(-) LVDS differential data input (Used for 8Bits LVDS Input; NC for 6Bits)
18	RIN3+	Positive(+) LVDS differential data input (Used for 8Bits LVDS Input; NC for 6Bits)
19	REVERSE	Display Reversed Function (VCC: Display Reverse; GND/NC: Normal Display)
20	NC/GND	Test Function Pin(Do not set this pin to High)

7.2 BACKLIGHT

CN201: BHSR-02VS-1/Locking

Adaptable connector: SM02B-BHSS-1-TB

Pin No.	Signal name	Function
1	VH1	High voltage input terminal for upper lamp (Cable color: Blue)
2	VL1	Low voltage input terminal for upper lamp (Cable color: Black)

CN202: BHSR-02VS-1 /Locking

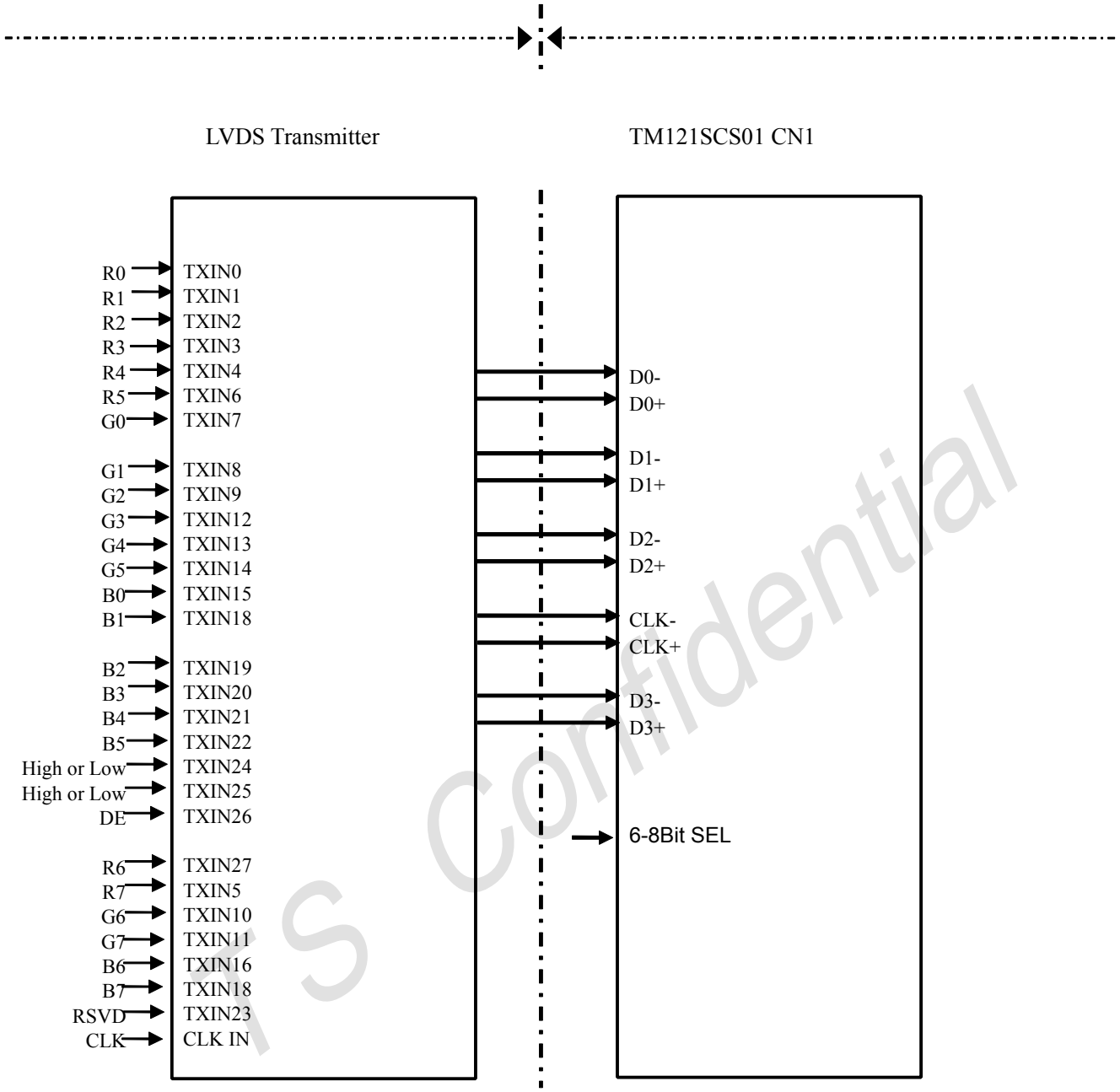
Adaptable connector: SM02B-BHSS-1-TB

Pin No.	Signal name	Function
1	VH2	High voltage input terminal for upper lamp (Cable color: Pink)
2	VL2	Low voltage input terminal for upper lamp (Cable color: White)

Note1: The ports of VDD and GND should be all used. As for the input of LVDS, please use the twisted pair wire of the transmission impedance 100Ω.

Note2: System ground (GND), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the product should be connected together in customer equipment.

CONNECTION BETWEEN RECEIVER AND TRANSMITTER FOR LVDS



Note1: The lowest bit (RA0, GA0, BA0, RB0, GB0, BB0), the most upper bit (RA7, GA7, BA7, RB7, GB7, BB7)

Note2:Connecting cable between LCD panel's connector and transmitter should use 100Ω twisted line.

Note3: If only Hsync and Vsync, the product don't work. Make sure DE signal has been input.

8. DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 16,777,216 colors in 256 scales. Also the relation between display colors and input data signals is as the following table.

Display colors		Data signal （0:Low level，1:High Level）																							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	Bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	Bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑					:								:								:			
	↓					:								:								:			
	Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

9. INTERFACE TIMING

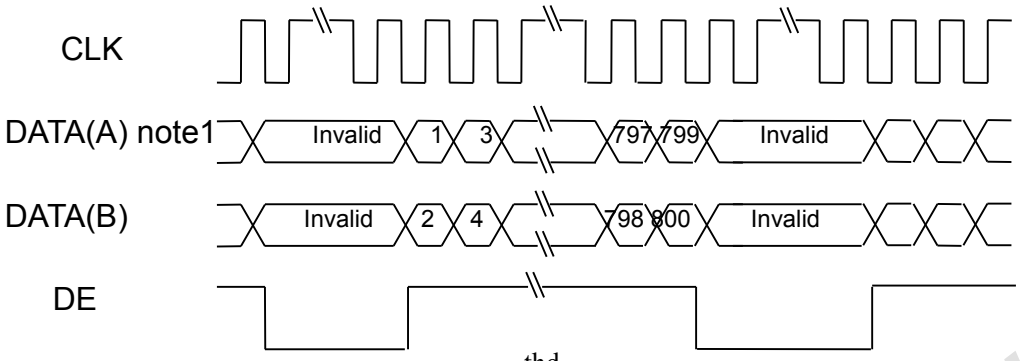
9.1 TIMING CHARACTERISTICS

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Clock	Frequency	1/tc	33.16	39.80	49.74	MHz	LVDS transmitter input
		tc	30.16	25.13	20.10	ns	
	Rise time, Fall time	-	Refer to the timing characteristics of LVDS transmitter			ns	Note 1
	Duty	-				-	
Horizontal signals	Cycle	th	14.8	18.0	26.5	μs	55.5kHz(typ.)
			920	1056	1240	CLK	
	Display period	thd	800			CLK	-
Vertical signals	Cycle	tv	13.3	16.67	20	ms	60.0Hz(typ.)
			608	628	650	H	
	Display period	tvd	600			H	-
DE/Data	Setup time	-	Refer to the timing characteristics of LVDS transmitter			ns	Note 1
	Hold time	-				ns	
	Rise time, Fall time	-				ns	

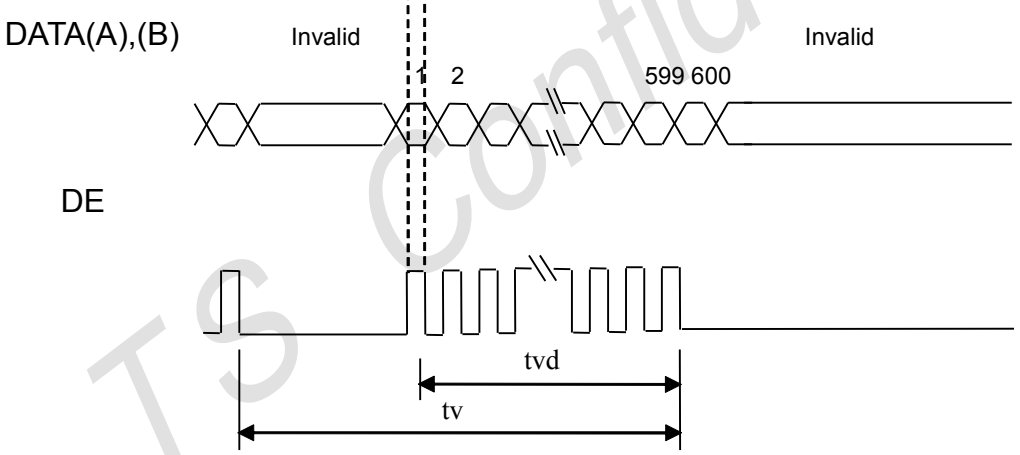
Note1: See the data sheet of LVDS transmitter.

9.2 INPUT SIGNAL TIMING CHART

Horizontal timing



Vertical timing



Note 1:

DATA(A)=RA0-RA7,GA0-GA7,BA0-BA7

DATA(B)=RB0-RB7,GB0-GB7,BB0-BB7

9.3 PIXEL DATA ALIGNMENT OF DISPLAY IMAGE

The following chart is the coordinates of per pixel

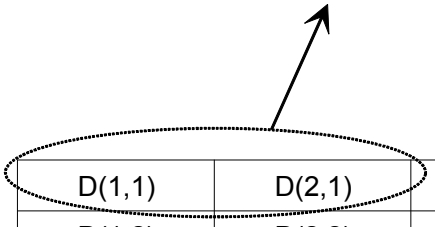
Odd Pixel: RA= R DATA Even Pixel : RB=R DATA

GA= G DATA GB=G DATA

BA= B DATA BB=B DATA

D(1,1) D(2,1)

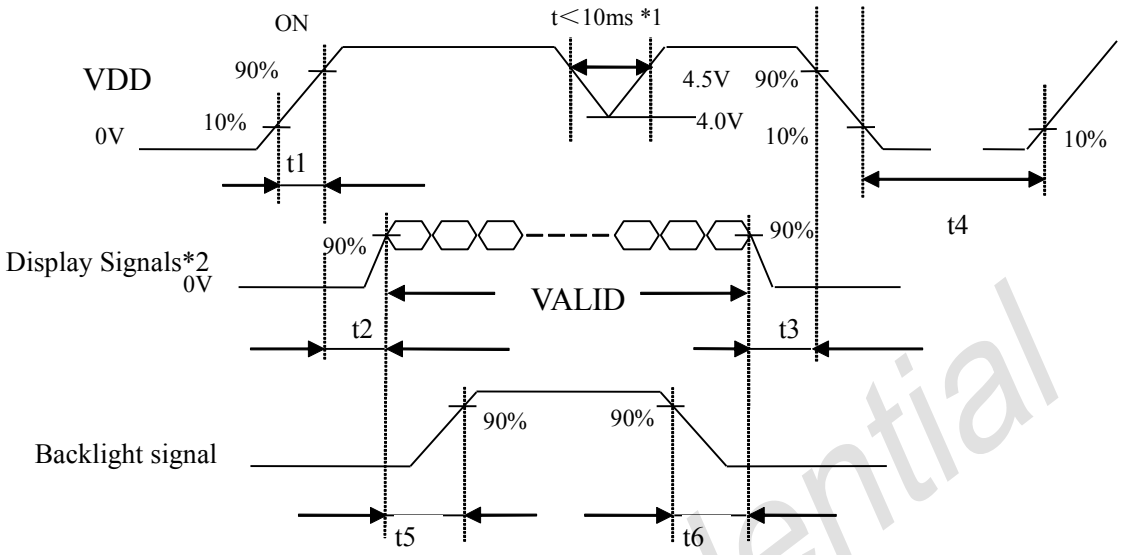
RA	GA	BA	RB	GB	BB



D(1,1)	D(2,1)	D(3,1)	•••	D(1440,1)
D(1,2)	D(2,2)	D(3,2)	•••	D(1440,2)
D(1,3)	D(2,3)	D(3,3)	•••	D(1440,3)
•	•	•	•••	•
•	•	•	•••	•
•	•	•	•••	•
D(1,900)	D(2,900)	D(2,900)	•••	D(1440,900)

9.4. POWER SUPPLY VOLTAGE SEQUENCE

9.4.1 The sequence of backlight and power



Timing Specifications:

t1 :0.47ms<t1 <10ms;

t2 :0.5 ms<t2 <50ms;

t3 :0ms<t3 <50ms;

t4 :t4 >1000ms;

t5 :t5 >200ms;

t6 :t6 >200ms;

*1. When VDD is on, but the value is lower than 4.5V, a protection circuit may work, then the module may not display.

*2 The signal line is not connected with the module, at the end of cable the terminal resistor of 100Ω should be added.

Note1: Display signals (D0+/-, D1+/-, D2+/-, D3+/- and CK+/-) must be “0” voltage, exclude the VALID period (See above sequence diagram). If these signals are higher than 0.3 V, the internal circuit is damaged.

If some of display signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If customer stops the display signals, they should cut VDD.

Note2: When VDD is on, it should be set above 4.0V.

Note3: The backlight power supply voltage should be inputted within the valid period of display and function signals, in order to avoid unstable data display.

9.4.2 Power supply voltage ripple

When the power supply is designed, the next form can give the reference. If the voltage ripple is over the value in next form, the noise should be seen in display area.

Ripple (Measured at input terminal of power supply)

	VDD (3.3V to drive the panel)
Ripple voltage	≤200mVP-P（Including spike noise）

9.4.3 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	FCC16152ABTP	KAMAYA	1.5A 32V	3.0A	Note1

Note1: There are different power supply systems from the power input terminal. The power supply capacity should be less than the fusing current. If the power supply capacity is above the fusing current, the fuse may blow in a short time, and then nasty smell, smoking and so on may occur.

10. OPTICS

10.1 Optical characteristics

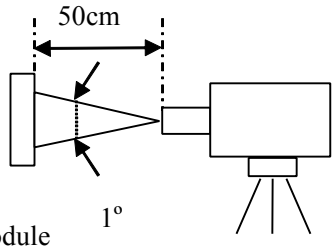
Note1 ,Note2

Parameter Note1		Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance		White at center θR=0°, θL=0° θU=0°, θD=0°	L	(320)	400	-	cd/m^2	-
Contrast ratio		White/Black at center θR=0°, θL=0° θU=0°, θD=0°	CR	(400)	600	-	-	Note3
Luminance uniformity		White θR=0°, θL=0° θU=0°, θD=0	LU	-	1.25	(1.33)	-	Note4
Chromaticity	White	X coordinate	Wx		0.313		-	Note5
		Y coordinate	Wy		0.329		-	
	Red	X coordinate	Rx	-	TBD	-	-	
		Y coordinate	Ry	-	TBD	-	-	
	Green	X coordinate	Gx	-	TBD	-	-	
		Y coordinate	Gy	-	TBD	-	-	
	Blue	X coordinate	Bx	-	TBD	-	-	
		Y coordinate	By	-	TBD	-	-	
Color gamut		θR=0°, θL=0°, θU=0°, θD=0 At center,against NTSC	C	-	55	-	%	
Response time		White to black	Ton	-	10	(20)	ms	Note6 Note7
		Black to white	Toff	-	25	(30)	ms	
		Ton+ Toff	-	-	35	(50)	ms	
Viewing angle	Right	θU=0°, θD=0°, CR≥10	θR	-	70	-	°	Note8
	Left	θU=0°, θD=0°, CR≥10	θL	-	70	-	°	
	Up	θR=0°, θL=0°, CR≥10	θU	-	50	-	°	
	Down	θR=0°, θL=0°, CR≥10	θD	-	60	-	°	

Note1: The values in upper table are only initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VDD= 5.0V, IBL= 6.5mArms/lamp, Display mode: WXGA+,
Horizontal cycle=55.56KHz, Vertical cycle=60.0Hz
Optical characteristics are measured at luminance saturation after 30minutes from working the product in the dark room. Also measurement method for luminance is as follows.



LCD module
(Product)

Luminance Meter (TOPCON BM-5A)
Spectroradiometer(TOPCON SR-3)

Note 3: See**"10.2 Definition of contrast ratio".**

Note 4: See**"10.3 Definition of luminance uniformity".**

Note 5: CIE 1931 Chromaticity Diagram Standard.

Note 6: Product surface temperature: TopF = 33.0 °C

Note 7: See **"10.4 Definition of response time".**

Note 8: See **"10.5 Definition of viewing angle".**

10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

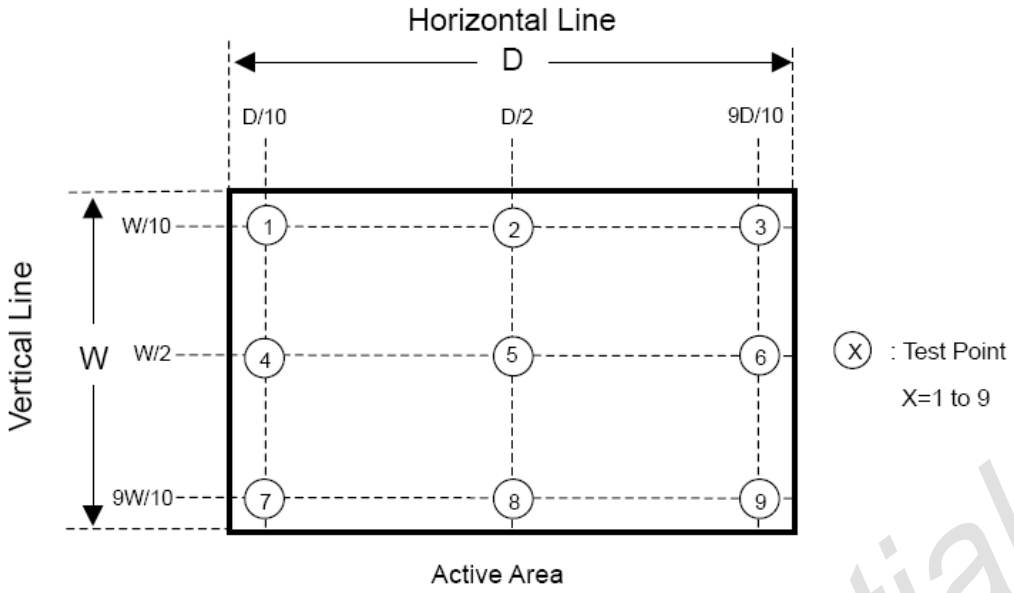
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using the following formula.

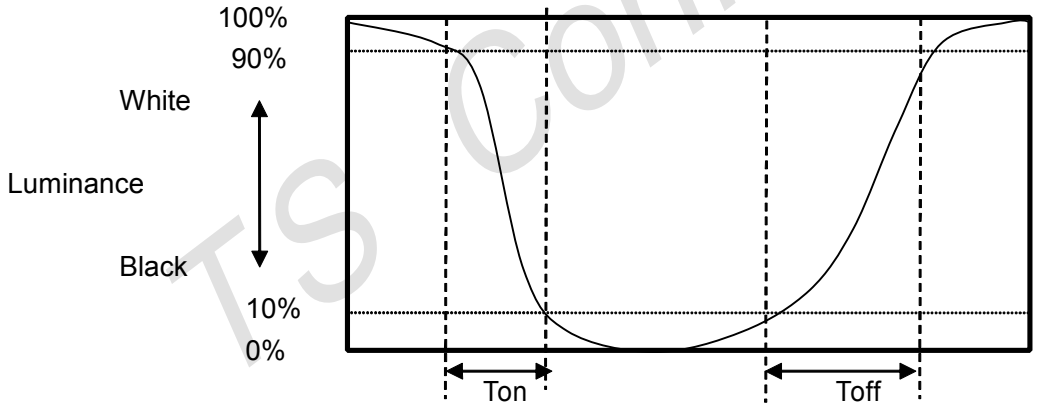
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑨}}{\text{Minimum luminance from ① to ⑨}}$$

The luminance is measured at near the 9 points shown below.



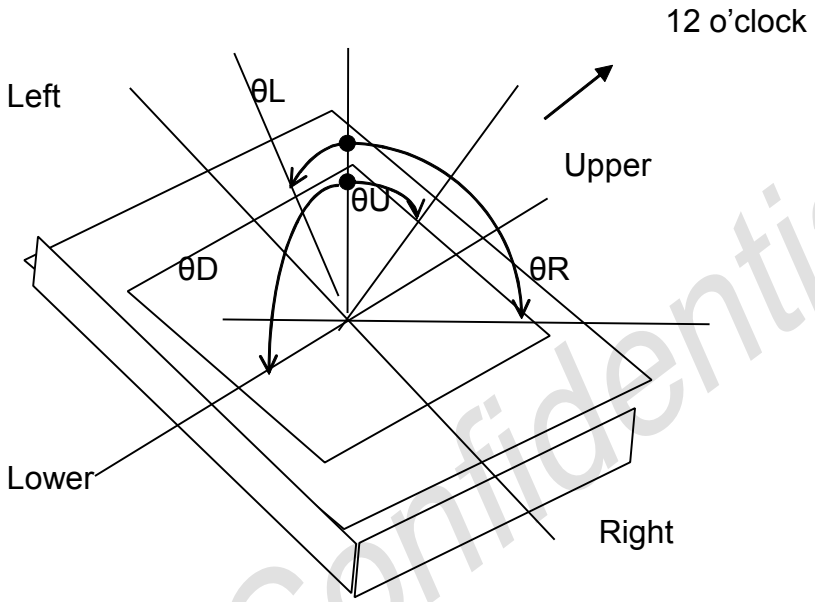
10.4 Definition of response times

Response time is measured, the luminance changes from “white” to “black”, or “black” to “white” on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 90% down to 10%. Also Toff is the time it takes the luminance change from 10% up to 90%. (See the following diagram.)



Normal axis (Perpendicular)

10.5 Definition of viewing angles



11. PACKING, TRANSPORTATION AND DELIVERY

TSD will pack products to deliver to customer in accordance with TSD packing specifications, and will deliver products to customer in such a state that products will not suffer from a damage during transportation .The delivery conditions are as follows.

PACKING

(1) Packing box

8 products are packed up with the maximum in a packing box(See "**OUTLINE FIGURE FOR PACKING** ").

Products are put into a plastic bag for prevention of moisture with cushion, and then the bag is sealed up with heat sealing.

The type name and quality are shown on outside of the packing box, either labeling or printing.

(2) Pallet Packing (See**OUTLINE FIGURE FOR PACKING** ")

① Packing boxes are tired on a cardboard pallet.(8 boxes×4 tiers maximum)

② Cardboard sleeve and top cap are attached to the packing boxes, then they are fixed by a band.

INSPECTION RECORD SHEET

Inspection record sheets are included in the packing box with delivery products to customer. It is summarized to a number of products for pass/fail assessment.

TRANSPORTATION

The product is transported by vehicle, aircraft or shipment in the state of pallet packing.

SIZE AND WEIGHT FOR PACKING BOX

Parameter	Packing box	Unit
Size	485（L）× 280（W）× 330（H）(typ.)	mm
Weight	TBD	kg
Total weight	TBD	kg

OUTLINE FIGURE FOR PACKING

TBD

12.OUTDRAWING