

LCD Module

Product Specification

: APPROVAL FOR SPECIFICATION

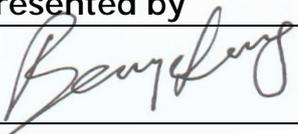
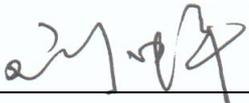
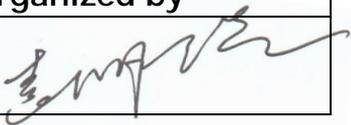
For Customer : _____ : APPROVAL FOR SAMPLE

Module No. : TST150TC-L01

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	2011-12-5	Preliminary Release	StepheHunk

1. OUTLINE

TST150TC-L01 module 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 backlight. 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, 16.7 millions colors (6bit+FRC)
- Resolution XGA (1024× 768 pixels)
- Wide viewing angle 80°/80° (L/R); 80°/80° (U/D)
- High contrast ratio 600:1
- Module size 326.5 (H) ×253.5 (V) ×11.8 (D) mm
- Fast response time (Ton+ Toff= 8ms)
- High gamut (60%)
- Edge light type backlight (White-LED)
- Inverter less
- RoHS compliance PSWG Standard
- TCO 5.0 compliance

2. GENERAL SPECIFICATIONS

Display area	304.128 (W) x 228.096 (V) mm (typ.)
Diagonal size of display	38.0 cm (15.0 inches)
Drive system	a-Si TFT active matrix
Display color	16.7 M colors (6bit+ FRC)
Pixel	1,024 (H) × 768(V) pixels
Pixel arrangement	RGB vertical stripe
Dot pitch	0.099 (H) × 0.297(V) mm
Pixel pitch	0.297(H) × 0.297(V) mm
Module size	326.5 (H) ×253.5 (V) ×11.8 (D) mm
Weight	1000 g (typ.)
Contrast ratio	600 :1 (typ.)
Viewing angle	160°/ 160° (typ.)
Color gamut	60% (typ.)
Response time	8 ms (typ.)
Luminance	400 cd/m ² (typ.)
Transmissive Mode	Normally White
Surface Treatment	Anti Glare
Signal system	LVDS 1 port
Power supply voltage	LCD panel signal processing board: 3.3V
Backlight	White-LED
Power consumption	9.8 W (typ)

3. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Power Supply Voltage	VDD	-0.3 ~ +6.0	V	Ta = 25°C
Input voltage for signals	Vi	-0.3 ~ +3.3	V	Ta = 25°C
Light bar peak forward current	I _F	≤ 150	mArms	Note 3
Storage temperature	T _{st}	-30 ~ +80	°C	Note 4
Operating temperature	T _{op}	-20 ~ +70	°C	Note 4, 5
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.

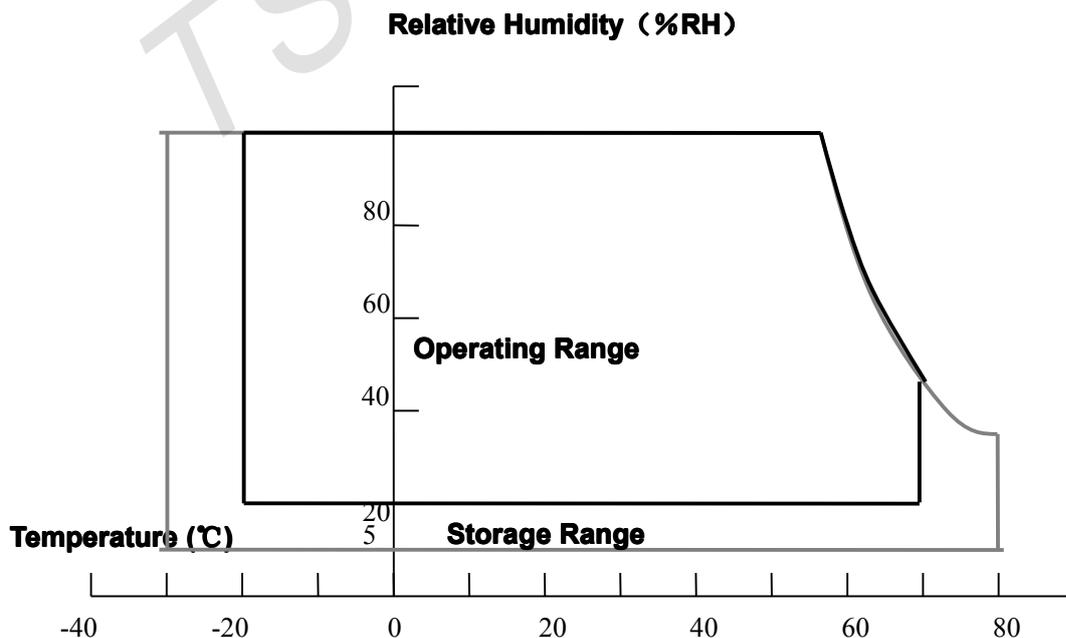
Note3: Temperature and relative humidity range is shown in the figure below.

(a) 90%RH Max. (Ta ≤ 40°C)

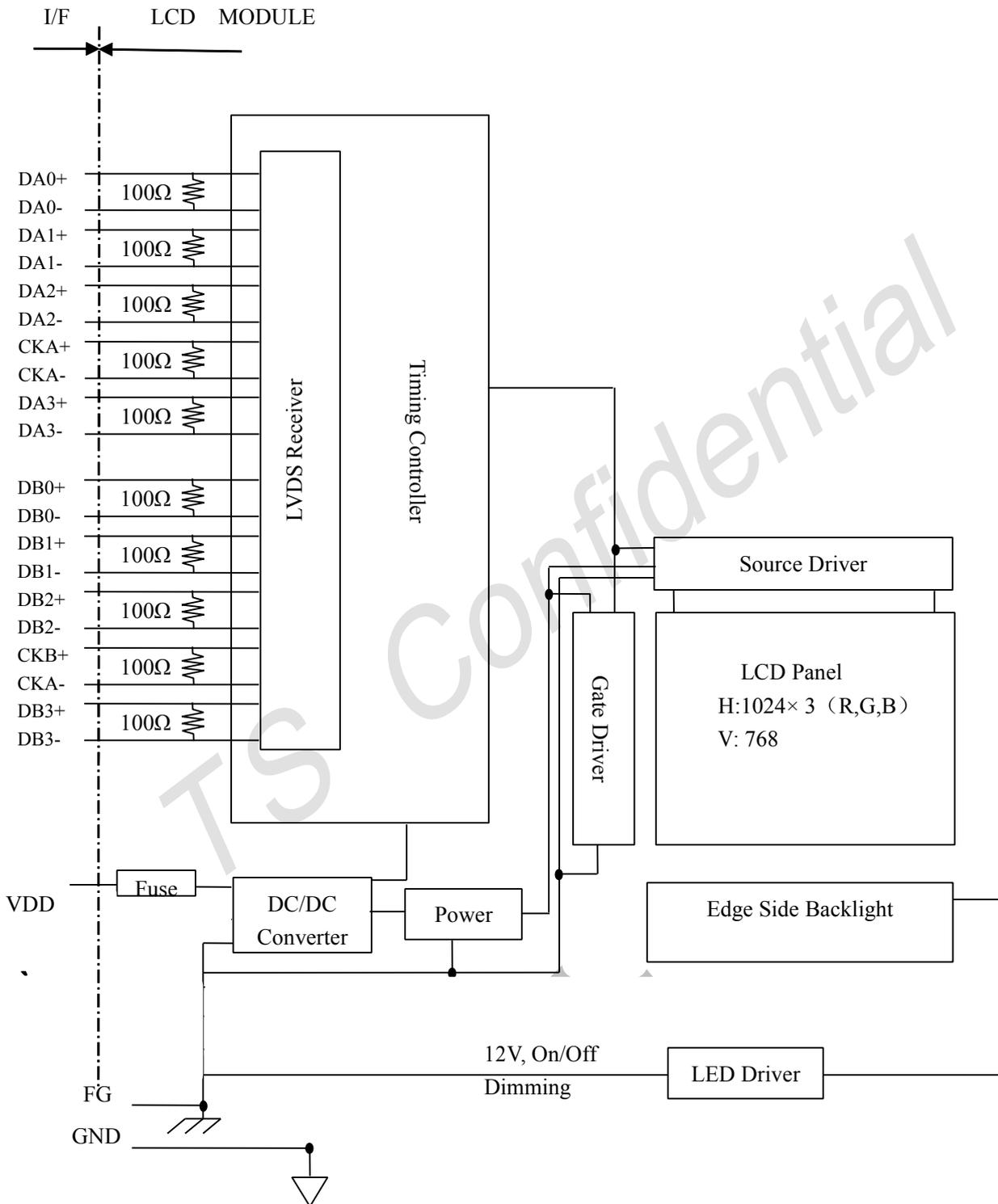
(b) Wet-bulb temperature should be 39°C Max. (Ta > 40°C)

(c) No condensation.

Note4: The temperature of panel display surface area should be -20°C Min and 80°C Max.



4. BLOCK DIAGRAM



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

5. ELECTRICAL CHARACTERISTICS

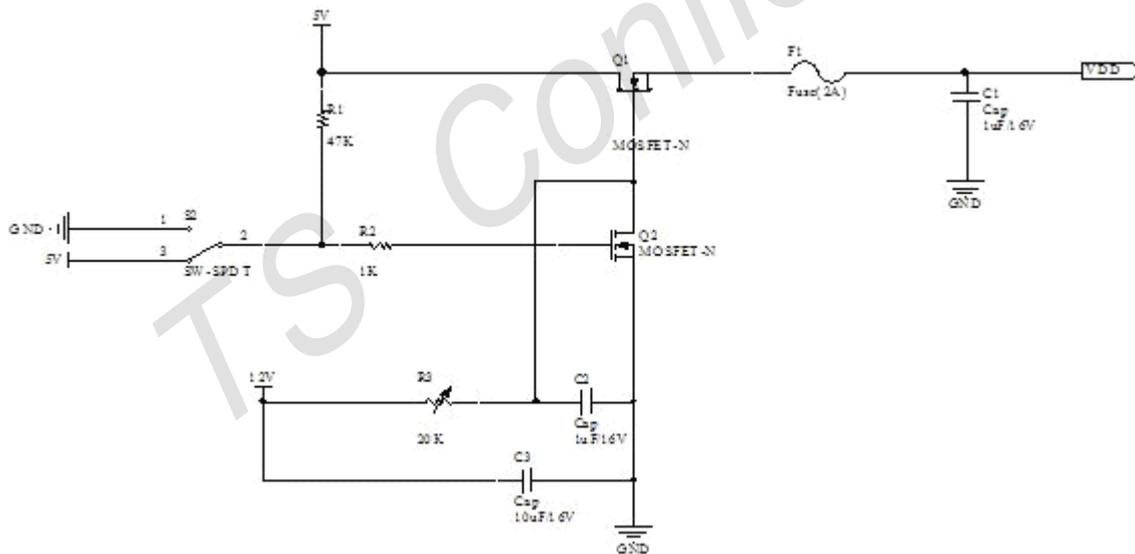
DRIVING FOR LCD

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage	VDD	3.0	3.3	3.6	V	-
Power supply current	IDD	-	500	550	mA	at VDD = 3.3V Note 1
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	
Input voltage width for LVDS receiver	Vi	0	-	2.4	V	-
Terminating resistor	RT	-	100	-	Ω	-
Rush current	I _{rush}	-	-	1.5	A	Note3

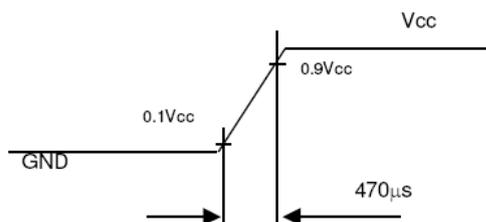
Note 1: All black pattern

Note 2: Common mode voltage for LVDS receiver

Note 3: Measurement Conditions:



Vcc rising time is 470 μ s



DRIVING FOR BACKLIGHT

(Ta=25°C) Note1

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Light bar operation voltage (for reference)	V _{LED}	17.5	-	23.1	Vrms	Operating with fixed driving current
Light bar operation current (pin)	I _{LED}	-	80	-	mArms	Note1
Light bar operating lifetime	Hr	50000	-	-	Hour	I _{LED} =80mA,Note3

Note1: The backlight of this product is made up of 1 light bar, LED to be 3020, 28pieces, 7 serials and 2 x2 parallels.

Note2: The light bar can work normally if the PWM dimming ratio range is from 0% to 100% and the operation current is 80mA.

Note3: The operating lifetime is mean time to half-luminance. In case the product works under room temperature environment.

6. CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

CN1 socket(Module side): 185083-20121 (P-TWO ELECTRIC TECHNOLOGY CO., LTD.)

Pin No.	Symbol	Signal	Remarks
1	VCC	Power supply	-
2	VCC		
3	GND	Ground	-
4	GND		
5	D0-	Pixel data	Note2
6	D0+		
7	GND	Ground	-
8	D1-	Pixel data	Note2
9	D1+		
10	GND	Ground	-
11	D2-	Pixel data	Note2
12	D2+		
13	GND	Ground	-
14	CLK-	Pixel clock	Note2
15	CLK+		
16	GND	Ground	-
17	D3-	Pixel data	Note2
18	D3+		
19	GND	Ground	-
20	MSL	Selection of LVDS input Map	Low or Open: NOTE1

Note1: See“7.4 Connection between receiver and transmitter For LVDS”.

Note2: Twist pair wires with 100Ω (Characteristic impedance) should be connected between LCD panel signal processing board and LVDS transmitter.

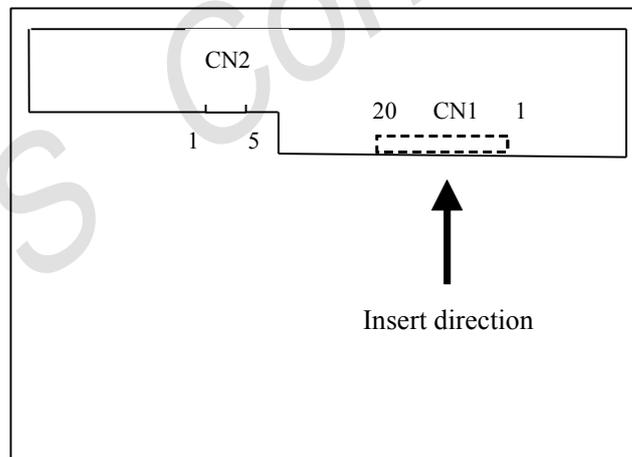
BACKLIGHT

CN2: MSB24038P5 (Produced by STM) or equivalent.

Pin	Symbol	Signal Name
1	Vcc	12V
2	GND	GND
3	Enable	5V-On / 0V-Off
4	Dimming	PWM Dimming
5	NC	NC

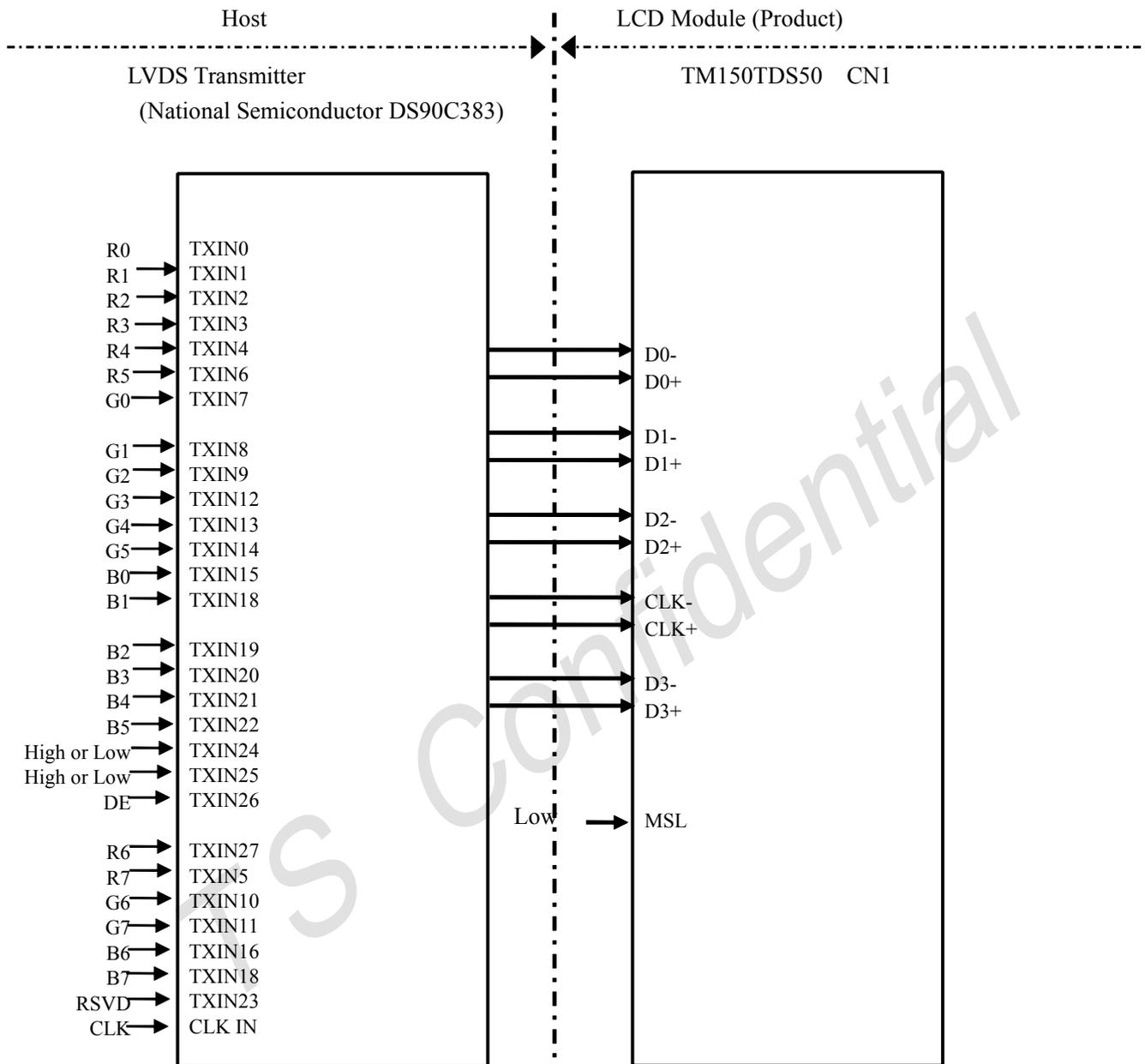
PWM Dimming:

Parameter		Symbol	min.	typ.	max.	Unit
PWM Input Threshold Voltage	Logic-High	V_{PWMH}	1.2	-	-	V
	Logic-Low	V_{PWML}	-	-	0.4	V
PWM Input Frequency		$1/T_{PWM}$	100	200	10K	Hz

POSITION OF PLUGS AND A SOCKET

CONNECTION FOR LVDS

Input LVDS map (MSL: "Low" or "Open")



Note1: Recommended transmitter. See the data sheet for DS90C383 (National Semiconductor) .

Note2: LSB (Least Significant Bit) -R0,G0,B0 MSB (Most Significant Bit) -R7,G7,B7

7. 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
Red	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	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
Green	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	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
Blue	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	1	1	1	1	1	1	1	1	

8. INTERFACE TIMING

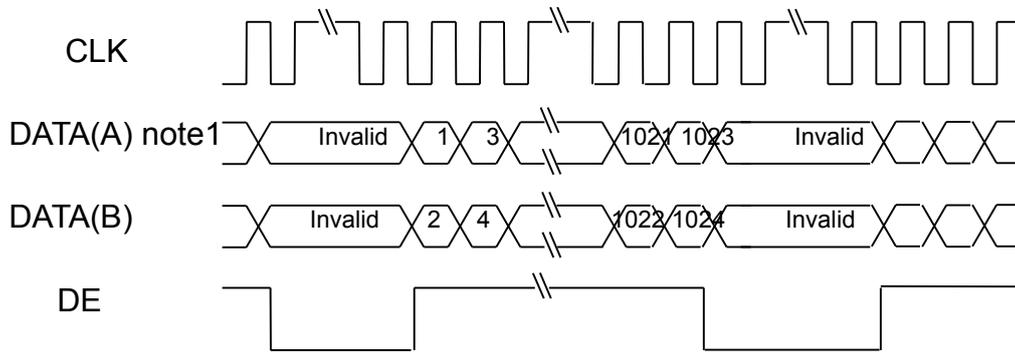
TIMING CHARACTERISTICS

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Clock	Frequency	1/tc	59.58	65.0	81.25	MHz	LVDS transmitter input
		tc	16.8	15.4	12.31	ns	
	Rise time, Fall time	-	Refer to the timing characteristics of LVDS transmitter			ns	Note 1
	Duty	-				-	
Horizontal signals	Cycle	th	15	20.676	26.5	μs	55.5kHz(typ.)
			1050	1344	1800	CLK	
	Display period	thd	1024				-
Vertical signals	Cycle	tv	13.1	16.67	20	ms	60.0Hz(typ.)
			770	806	1334	H	
	Display period	tvd	768				-
DE/Data	Setup time	-	Refer to the timing characteristics of LVDS transmitter			ns	Note 1
	Hold time	-				ns	
	Rise time, Fall time	-				ns	

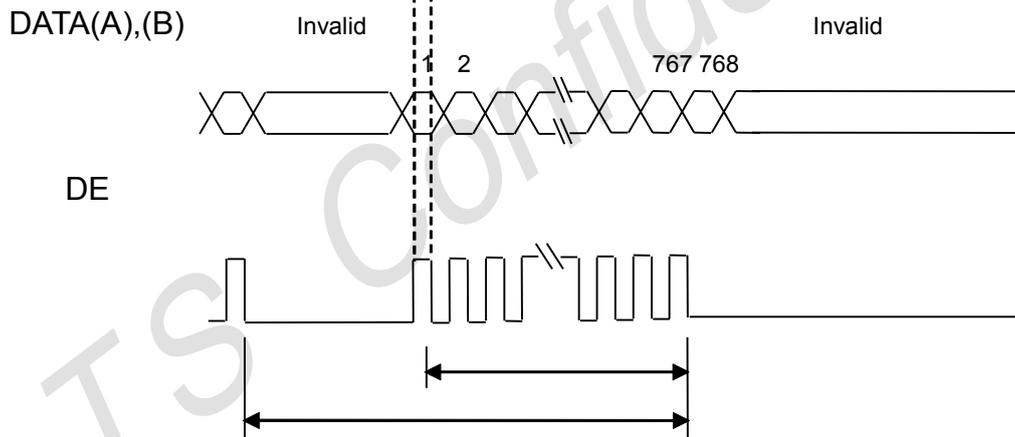
Note1: See the data sheet of LVDS transmitter.

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

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

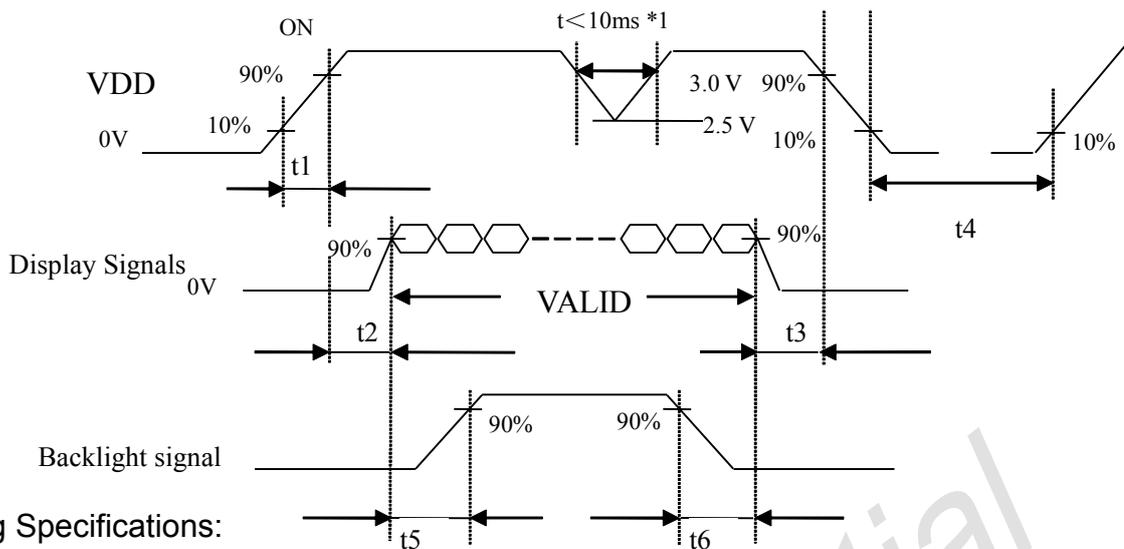
BB=B DATA

D(1,1)			D(2,1)		
RA	GA	BA	RB	GB	BB

D(1,1)	D(2,1)	D(3,1)	...	D(1024,1)
D(1,2)	D(2,2)	D(3,2)	...	D(1024,2)
D(1,3)	D(2,3)	D(3,3)	...	D(1024,3)
.
.
.
D(1,768)	D(2,768)	D(3,768)	...	D(1024,768)

POWER SUPPLY VOLTAGE SEQUENCE

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)

FUSE

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	FCC16152ABTP	KAMAYA	1.5A 36V	3.0 A	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.

9. OPTICS

Optical characteristics

Note1 ,Note2

Parameter Note1		Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance		White at center $\theta R=0^\circ, \theta L=0^\circ$ $\theta U=0^\circ, \theta D=0^\circ$	L	350	400	-	cd/ m ²	-
Contrast ratio		White/Black at center $\theta R=0^\circ, \theta L=0^\circ,$ $\theta U=0^\circ, \theta D=0^\circ$	CR	400	600	-	-	Note3
Luminance uniformity		White $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0$	LU	-	1.25	1.33	-	Note4
Chromaticity	White	X coordinate	Wx	0.283	0.313	0.343	-	Note5
		Y coordinate	Wy	0.299	0.329	0.359	-	
	Red	X coordinate	Rx	0.601	0.631	0.661	-	
		Y coordinate	Ry	0.325	0.355	0.385	-	
	Green	X coordinate	Gx	0.314	0.344	0.374	-	
		Y coordinate	Gy	0.578	0.608	0.638	-	
Blue	X coordinate	Bx	0.123	0.153	0.183	-		
	Y coordinate	By	0.057	0.087	0.117	-		
Color gamut		$\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0$ At center,against NTSC	C	50	60	-	%	
Response time		White to black	Ton	-	3	5	ms	Note6 Note7
		Black to white	Toff	-	5	7	ms	
		Ton+ Toff	-	-	8	12	ms	
Viewing angle	Right	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θR	70	80	-	°	Note8
	Left	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θL	70	80	-	°	
	Up	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	θU	70	80	-	°	
	Down	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	θD	70	80	-	°	

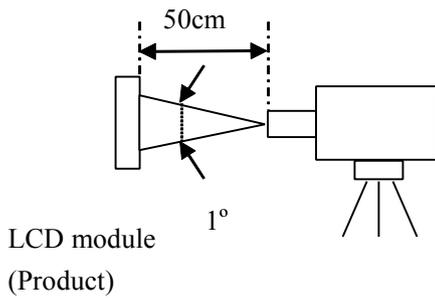
Note1: The values in upper table are only initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VDD= 3.3V, IBL= 80mA/Arms/led, Display mode: XGA,

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.



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

- Note 3: See “ **Definition of contrast ratio**”.
- Note 4: See “ **Definition of luminance uniformity**”.
- Note 5: CIE 1931 Chromaticity Diagram Standard.
- Note 6: Product surface temperature: TopF = 33.0 °C
- Note 7: See “ **Definition of response time**”.
- Note 8: See “ **Definition of viewing angle**”.

Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

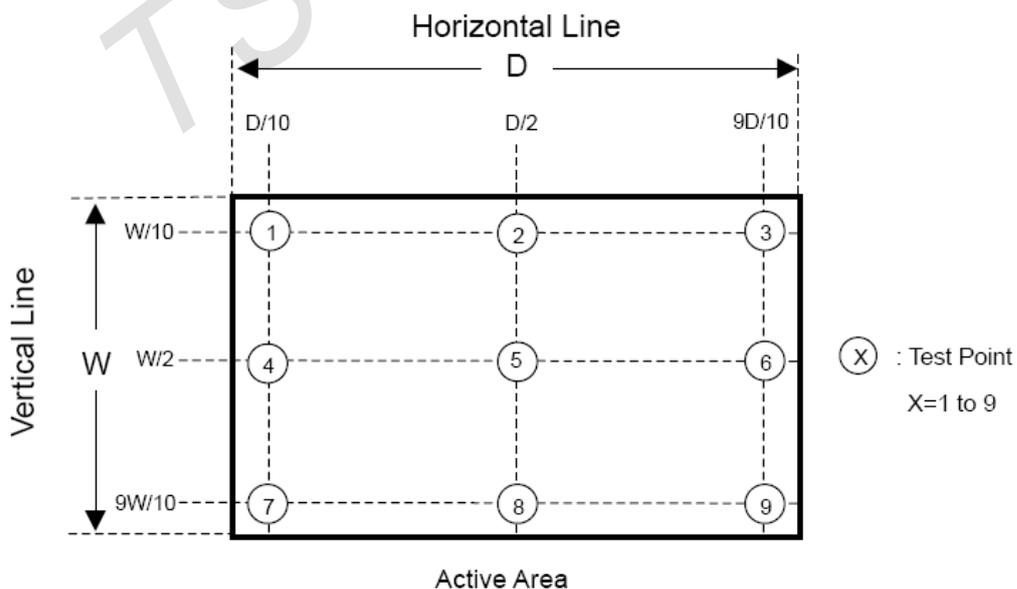
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

Definition of luminance uniformity

The luminance uniformity is calculated by using the following formula.

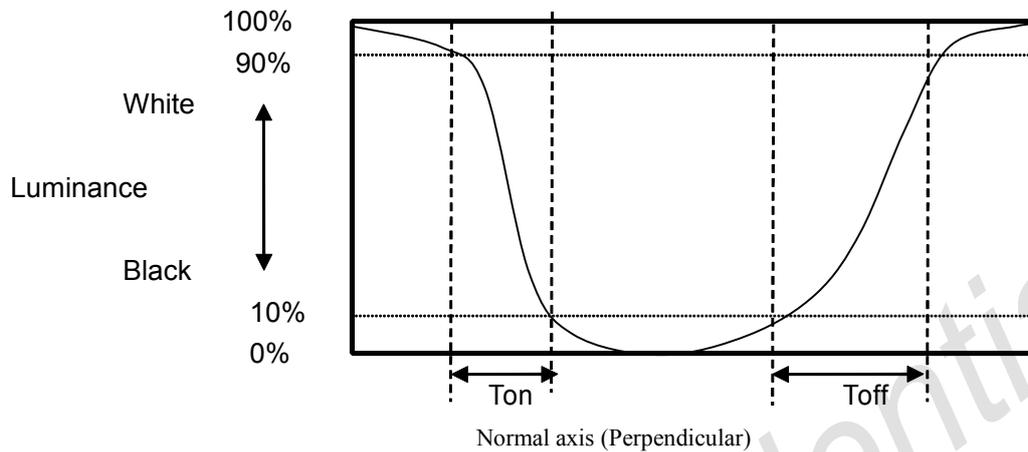
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑨}}{\text{Minimum luminance from ① to ⑨}}$$

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

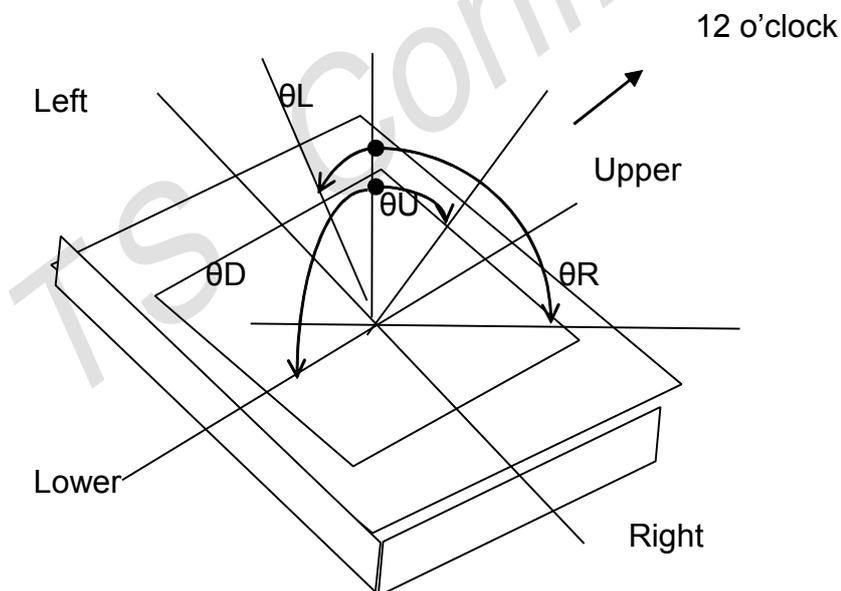


Definition of response times

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.)



Definition of viewing angles



10. 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

6 products are packed up with the maximum in a packing box

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

- ① Packing boxes are tied on a cardboard pallet. (8 boxes×4 tiers maximum)
- ② Cardboard sleeve and top cap are attached to the packing boxes, and 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	378 (L) x368 (W) x315.5 (H) (typ.)	mm
Weight	1 (typ.)	kg
Total weight	14.6 (typ.) (with 14 products)	kg

