Shanghai AVIC OPTOELECTRONICS Co. Ltd

TFT COLOR LCD OPEN CELL

(COMMON)

TMS156WX1-02TC

39.5cm (15.6 Type)

WXGA

LVDS Interface (1port)

DATA SHEET

(Version 2.0)

Published by

Product Technology Department

Shanghai AVIC OPTOELECTRONICS Co. Ltd

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CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

TMS156WX1-02TC open cell 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.

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.

Color (Red, Green, Blue) data signals from a host system (e.g. PC, signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATIONS

• Small Monitor / TV application

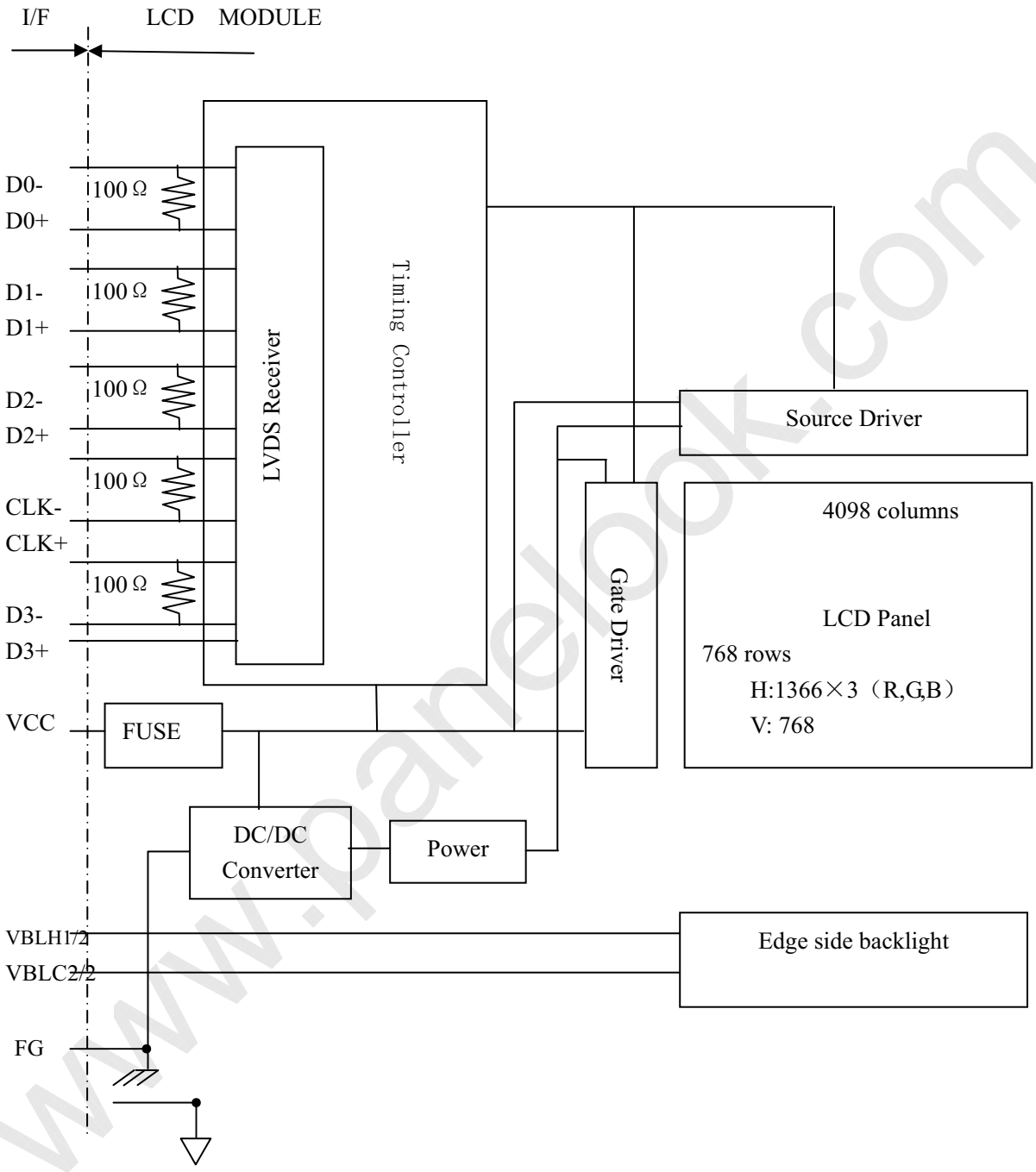
1.3 FEATURES

• a-Si TFT active matrix
• LVDS interface
• R.G.B input 8bit, 16.77 millions colors (6bit+Hi-FRC)
• Resolution WXGA+ :(1,366×768 pixels)
• High response time (Ton+Toff=8 ms）

2. GENERAL INFORMATION

Display area	344.232 (W) x 193.536 (H) mm (typ.)
Drive system	a-Si TFT active matrix
Display color	16.77M colors (6bit+Hi-FRC)
Pixel	1,366 (H) x 768(V) pixels
Pixel arrangement	RGB (Red dot、Green dot、 Blue dot) vertical stripe
Pixel pitch	0.252 (H) x 0.252 (V) mm
Power supply voltage	LCD panel signal processing board：5.0V

3. BLOCK DIAGRAM



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

4. DETAILED SPECIFICATION

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Display area	344.232 (W) x 193.536 (H) mm (typ.)	mm
Display dot number	1366×3(H) ×768(V)	-
Pixel pitch	0.252 (H) x 0.252 (V) mm	mm
Dot pitch	0.084(H) x 0.252 (V) mm	mm
Color arrangement	RGB (Red dot、Green dot、 Blue dot) vertical stripe	-
Display color	16,777,216(6bit+Hi FRC)	color

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal board	VCC	-0.3 ~ +6.0	V	Ta = 25℃
Input voltage for signals	Display signals Note1	Vi	-0.3 ~ +3.2	V	Ta = 25℃
Storage temperature		Tst	-20 ~ +60	℃	-
Operating temperature	Front surface	TopF	0 ~ +50	℃	Note2
	Rear surface	TopR	0 ~+55	℃	Note3
Relative humidity Note4		RH	≤ 90	%	Ta ≤ 40℃
			≤ 85	%	40 <Ta ≤50℃
Absolute humidity		AH	≤ 70 Note5	g/m^3	Ta > 50℃
Operating altitude		-	≤4,850	m	0°C≤Ta≤55°C
Storage altitude		-	≤13,600	m	-20°C≤Ta≤60°C

Note1: Display signals are D0+/-, D1+/-, D2+/-, D3+/- and CK+/-.

Note2: Measured at center of LCD panel surface (including self-heat)

Note3: Measured at center of LCD module's rear shield surface (including self-heat)

Note4: No condensation

Note5: Ta = 50℃, RH = 85%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 Driving for LCD panel signal processing board

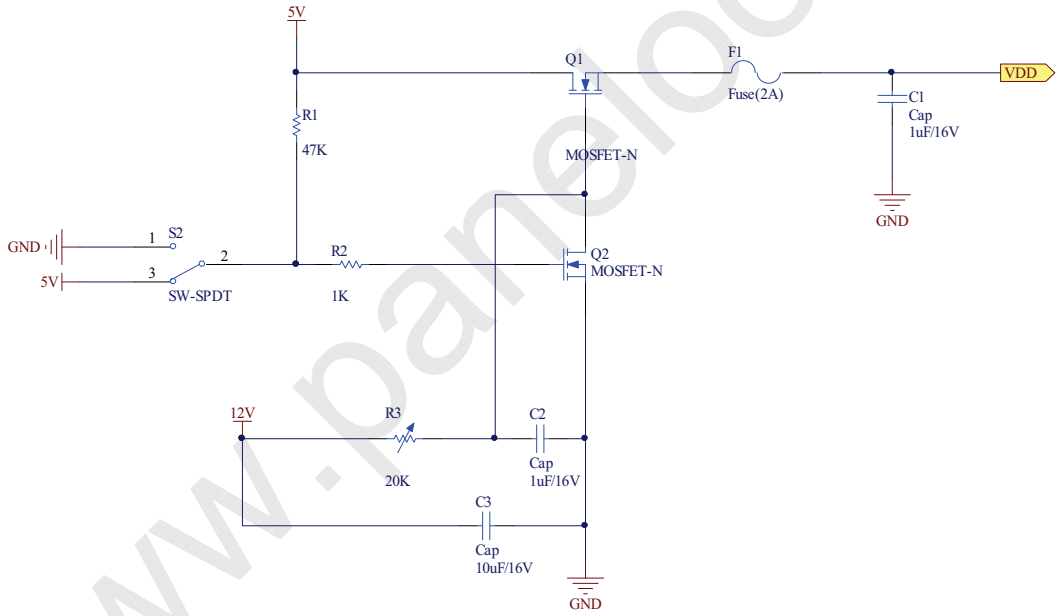
(Ta=25°C)

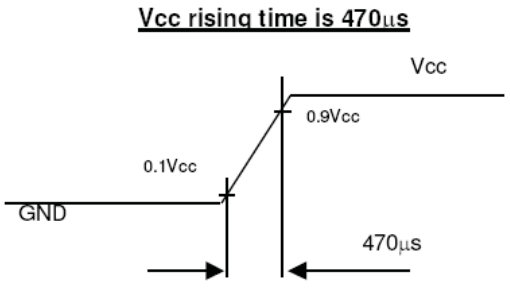
Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	4.5	5.0	5.5	V	-
Power supply current		ICC	-	400※1	（600）※2	mA	at VCC = 5.0V
Permissible ripple voltage		VRP	-	-	100	mV	For VCC
Differential input voltage		| Vid |	200	-	600	mV	-
Differential input threshold voltage for LVDS receiver	Low	VTL		-100		mV	at VCM = 1.25V ※3
	High	VTH	-	-	100	mV	
Input voltage width for LVDS receiver		Vi	0		2.5	V	-
Rush current		Irush	-	-	2.0	A	Note1.

※1: Checkered flag pattern (EIAJ ED-2522)；　※2: 2H1V dot inverse pattern

※3: Common mode voltage for LVDS receiver

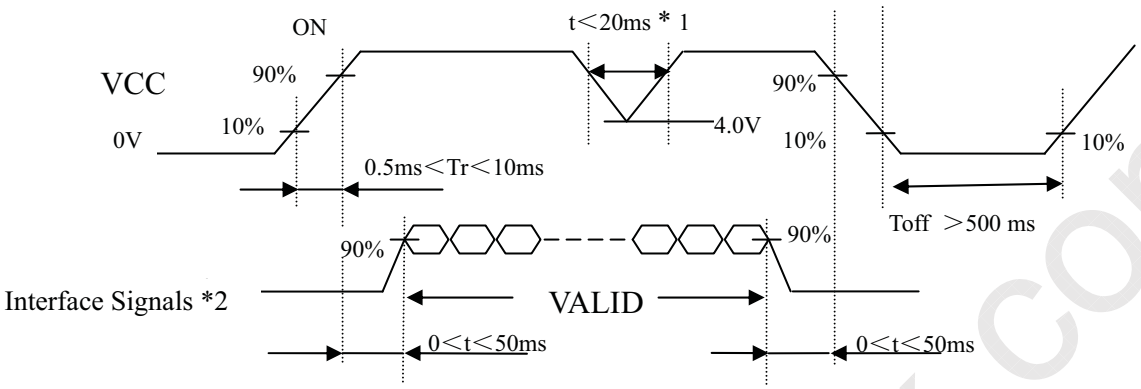
Note1.Measurement Conditions:





4.4 POWER SUPPLY VOLTAGE SEQUENCE AND RIPPLE

4.4.1 Power supply voltage sequence



*1: VCC should be above 4.0 V while VCC ON period.

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

Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 4.5 V, a protection circuit may work, and then this product may not work.

Note2: If some of interface 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 interface signals, they should cut VCC.

4.4.2 Power supply voltage ripple

This product works, even if the ripple voltage levels are beyond the permissible values as the following table, but there might be noise on the display image.

	VCC(5V to drive the panel)
Ripple voltage	≤100mV（Including spike noise）

4.4.3 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	F0603FA1500V032T	AEM	1.5 A 32 V	-	Note1

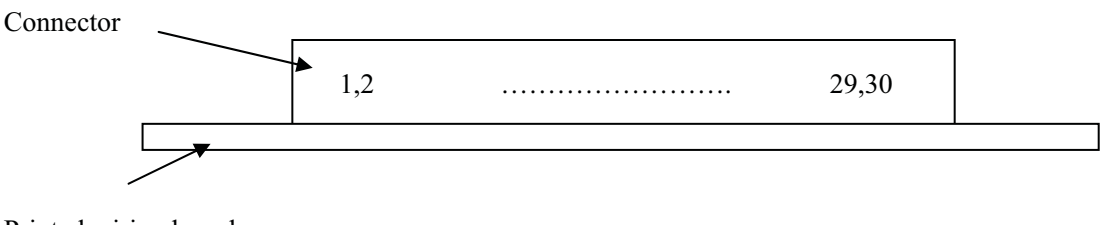
Note1: There are different power supply systems from the power input terminal. The power supply capacity should be less than the fusing current. If the power supply capacity is above the fusing current, the fuse may blow in a short time, and then nasty smell, smoking and so on may occur.

4.5 INTERFACE AND CONNECTOR PIN ALIGNMENT

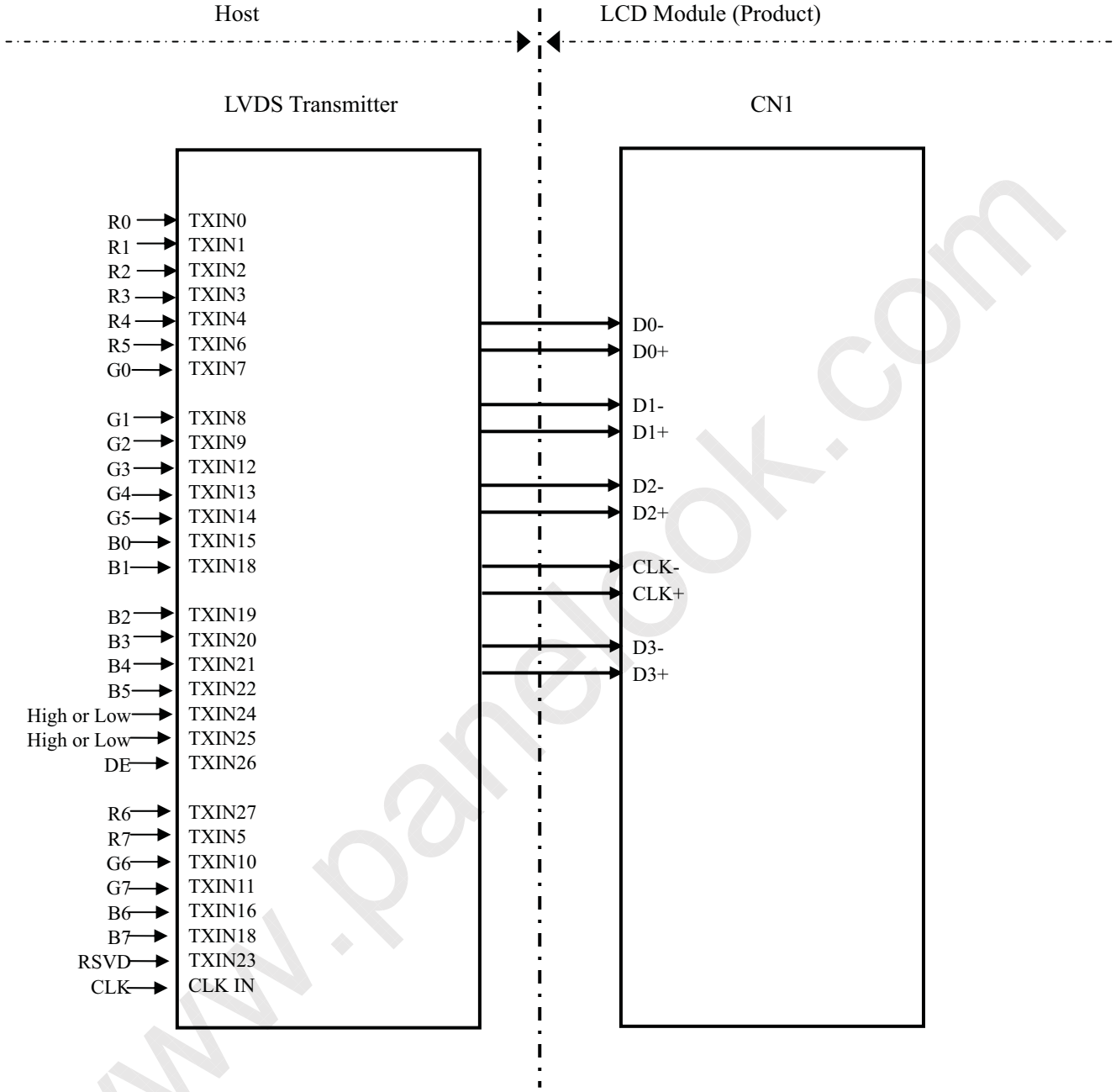
CN1: FI-X30SSL-HF or equivalent

Pin No.	Symbol	Description
1	NC	Not connection
2	NC	Not connection
3	NC	Not connection
4	GND	Ground
5	RX0-	Negative LVDS differential data input. Channel 0
6	RX0+	Positive LVDS differential data input. Channel 0
7	GND	Ground
8	RX1-	Negative LVDS differential data input. Channel 1
9	RX1+	Positive LVDS differential data input. Channel 1
10	GND	Ground
11	RX2-	Negative LVDS differential data input. Channel 2
12	RX2+	Positive LVDS differential data input. Channel 2
13	GND	Ground
14	RXCLK-	Negative LVDS differential clock input.
15	RXCLK+	Positive LVDS differential clock input.
16	GND	Ground
17	RX3-	Negative LVDS differential data input. Channel 3
18	RX3+	Positive LVDS differential data input. Channel 3
19	GND	Ground
20	NC	Not connection
21	NC	Not connection
22	NC	Not connection
23	GND	Ground
24	GND	Ground
25	GND	Ground
26	VCC	+5.0V power supply
27	VCC	+5.0V power supply
28	VCC	+5.0V power supply
29	VCC	+5.0V power supply
30	VCC	+5.0V power supply

CN1: The inserting side is as follows



4.6 LVDS I/F DATA CHART



4.7 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
		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

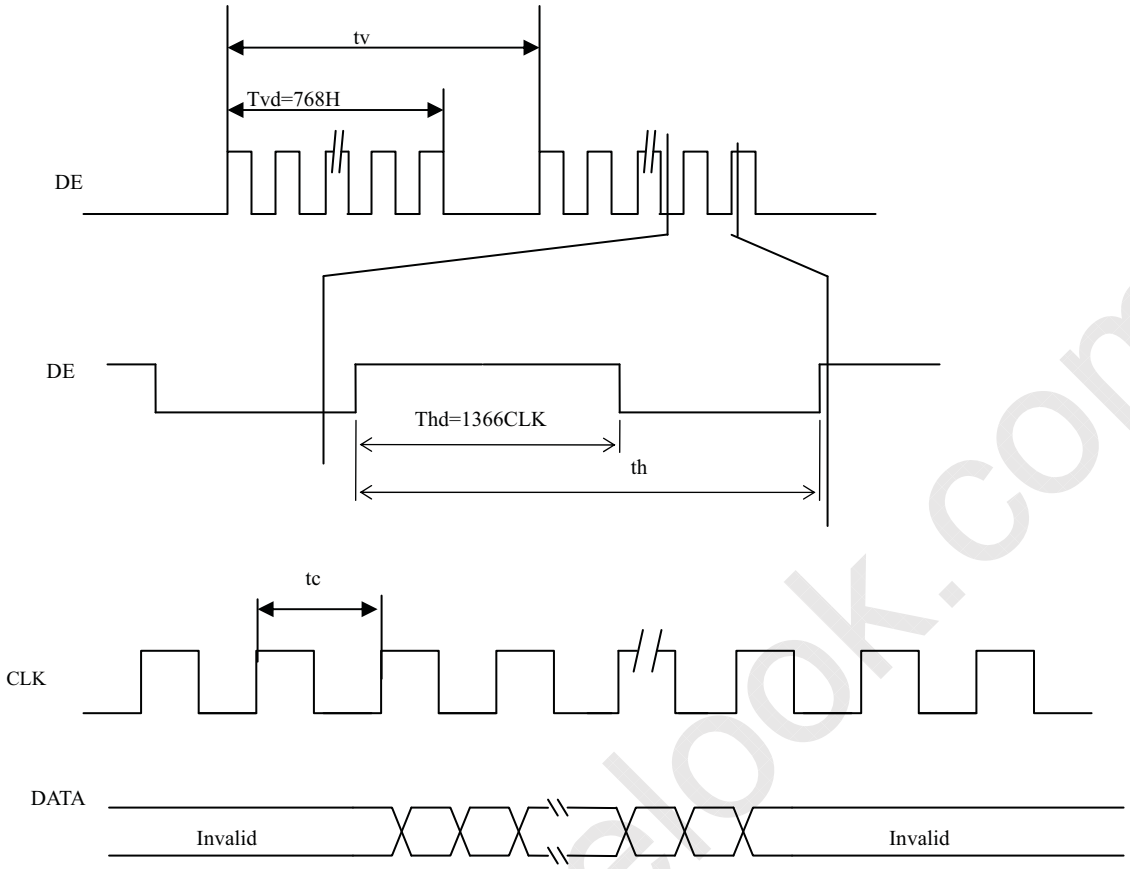
4.8 INTERFACE TIMING

4.8.1 Timing specification

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Clock	Frequency	1/tc	50	76	85	MHz	
		tc	-	13	-	ns	
	Rise time, Fall time	-	Refer to the timing characteristics of LVDS transmitter			ns	Note 1
	Duty	-				-	
Horizontal signals	Cycle	th	-	20.67	-	μs	48.4kHz(typ.)
			(1446)	1560	(1936)	CLK	
	Display period	thd	1366			CLK	-
Vertical signals	Cycle	tv	13.33	16.67	25.00	ms	60.0Hz(typ.)
			(778)	806	(888)	H	
	Display period	tvd	768			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.
Recommended transmitter: DS90CF383 (National Semiconducter)

4.8.2 Input signal timing chart



4.8.3 Pixel DATA alignment of display image

The following table is the coordinates per pixel

C（1，1）

R	G	B

C（1，1）	C（2，1）	•••	C（X，1）	•••	C（1365，1）	C（1366，1）
C（1，2）	C（2，2）	•••	C（X，Y）	•••	C（1365，2）	C（1366，2）
• • •	• • •	• ••• •	• • •	• ••• •	• • •	• • •
C（1，Y）	C（2，Y）	•••	C（X，Y）	•••	C（1365，Y）	C（1366，Y）
• • •	• • •	• ••• •	• • •	• ••• •	• • •	• • •
C（1，767）	C（2，767）	•••	C（X，767）	•••	C（1365，767）	C（1366，767）
C（1，768）	C（2，768）	•••	C（X，768）	•••	C（1365，768）	C（1366，768）

4.9 OPTICS(*BASED ON TFT LCD MODULE TMS156WX1-01TB*）

4.9.1 Optical characteristics

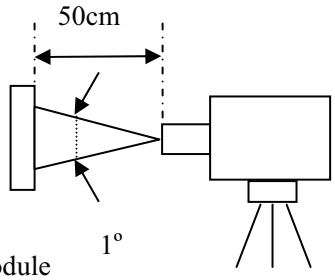
Note1 ,Note2

Parameter Note1		Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance		White at center θR=0°, θL=0°, θU=0°, θD=0°	L	(210)	250	-	cd/ m^2	-
Contrast ratio		White/Black at center θR=0°, θL=0°, θU=0°, θD=0°	CR	(350)	500	-	-	Note3
Luminance uniformity		White θR=0°, θL=0°, θU=0°, θD=0	LU	-	1.4	(1.5)	-	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	typ-0.03	0.637	typ+0.03	-	
		Y coordinate	Ry		0.333		-	
	Green	X coordinate	Gx		0.284		-	
		Y coordinate	Gy		0.596		-	
	Blue	X coordinate	Bx		0.154		-	
		Y coordinate	By		0.083		-	
Color gamut		θR=0°, θL=0°, θU=0°, θD=0 At center against NTSC	C	(58)	60	-	%	
Response time		White to black	Ton	-	2	(4)	ms	Note6 Note7
		Black to white	Toff	-	6	(12)	ms	
		Ton+ Toff	-	-	8	(16)	ms	
Viewing angle	Right	θU=0°, θD=0°,CR=10	θR	(40)	45	-	°	Note8
	Left	θU=0°, θD=0°,CR=10	θL	(40)	45	-	°	
	Up	θR=0°, θL=0°,CR=10	θU	(15)	20	-	°	
	Down	θR=0°, θL=0°,CR=10	θD	(40)	45	-	°	

Note1: The values in upper table are based on backlight provided by SAO..

Note2: Measurement conditions are as follows.

Ta=25°C，VCC=5.0V，IBL=7.0mArms/lamp，FO=55±5KHz，WXGA+，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"4.9.2 Definition of contrast ratio".
Note 4: See"4.9.3 Definition of luminance uniformity".
Note 5: CIE 1931 Chromaticity Diagram Standard.
Note 6: Product surface temperature: TopF = 33.0 ℃
Note 7: See "4.9.4 Definition of response time".
Note 8: See "4.9.5 Definition of viewing angle".

4.9.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

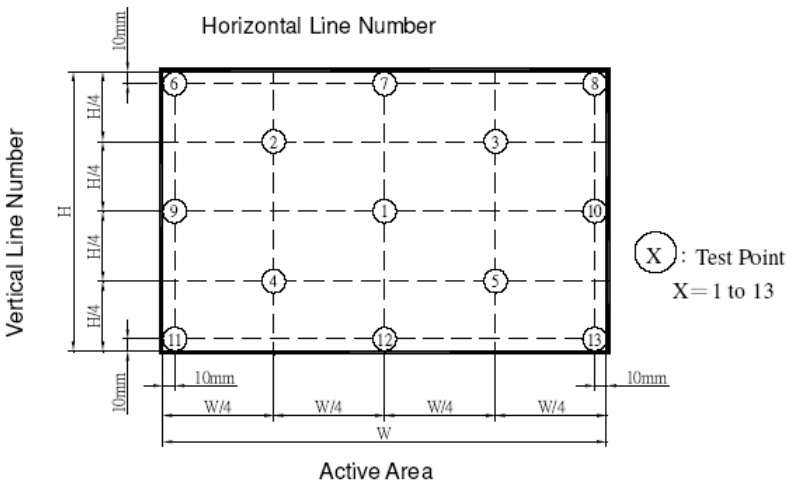
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.9.3 Definition of luminance uniformity

The luminance uniformity is calculated by using the following formula.

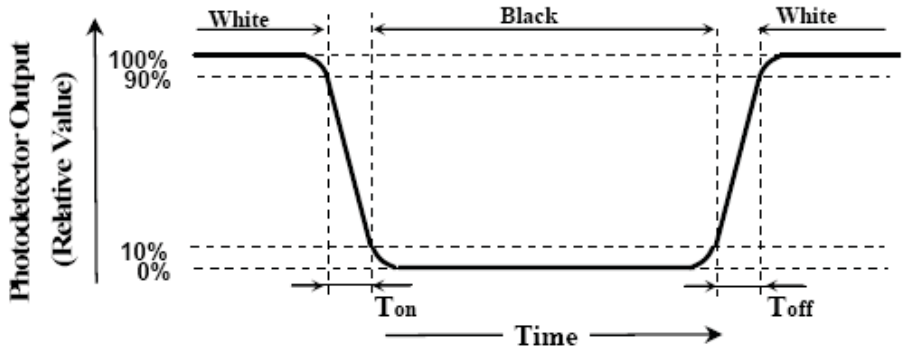
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from(1)to(13)}}{\text{Minimum luminance from(1)to(13)}}$$

The luminance is measured at near the 13points shown below.

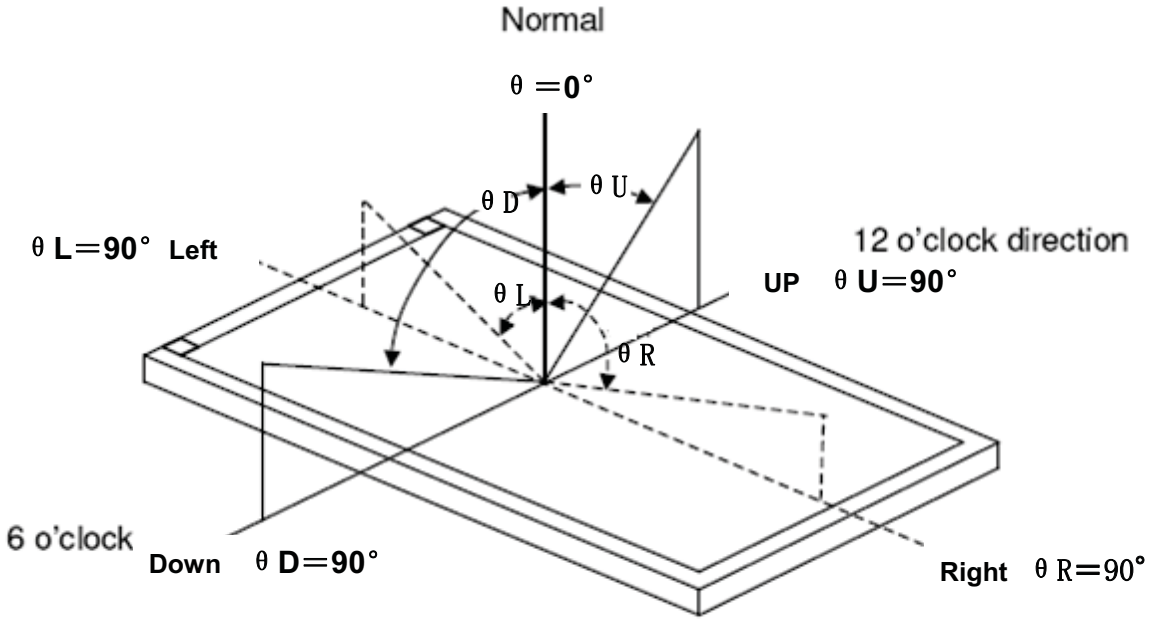


4.9.4 Definition of response time

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.)



4.9.5 Definition of viewing angle



4.9.6 B/L SPEC. for TMS156WX1-01TB

Parameter		Symbol	Condition	Min.	Typ.	Max.	unit	Remarks
Luminance (center)		L	I FL=7.0mA, 55kHz /25±3℃	2300	2400	—	cd / m2	Upright the B/L , then test at light-emitting area after 30min.
Luminance uniformity	5 point	ΔL1	I FL=7.0mA, 55kHz /25±3℃		1.2	1.25		Figure 1
	13 point	ΔL2	I FL=7.0mA, 55kHz /25±3℃		1.4	1.5		
	Visual	—	—	To manage according to the lowest accepted spec.			—	-
Color gamut		X	I FL=7.0mA, 55kHz /25±3℃	0.292	0.308	0.323	—	-
		Y	I FL=7.0mA, 55kHz /25±3℃	0.285	0.300	0.315	—	-

Note1

Luminance uniformity 1	(the max. luminance of 1~5point) / the min. luminance of 1~5point)
Luminance uniformity 2	(the max. luminance of 1~13point) / (the min. luminance of 1~13point)

5. MARKINGS，PACKING, TRANSPORTATION AND DELIVERY

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

5.1 PRODUCT LABEL

Product label

Open cell barcode：

•Example: 6WX0218C23916121011H6H109505003

6WX02	18C239161210	11H6H109505003
Open cell Number Code	**Cell ID**	**Lot number**

Cell ID: 18C239161210

Jan. to Sep.: Number of month
October: A
November: B
December: C

1	8	C	23	9161210
S1 Line	Manufacturing year (e.g:A.D2008 is 08.)	Manufacturing month 1 letter	Manufacturing day	Panel Location Internal use

Lot number: 11H6H109505003

Jan. to Sep.: Number of month
October: A
November: B
December: C

11H6H1	09	5	05	003
Internal use	Manufacturing year 2 figures of the A.D. end numbers (e.g: A.D2009 is 09.)	Manufacturing month 1 letter	Manufacturing day	Production number Multi-letter (figure)

5.2 PACKING

(1) Packing box

5 products are packed up with the maximum in a packing box (See "**5.6 OUTLINE FIGURE FOR PACKING** ").

Products are put into a plastic bag for prevention of moisture.

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

(2)Pallet Packing (See"**5.6 OUTLINE FIGURE FOR PACKING** ")

① Packing boxes are tired on a cardboard pallet.

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

5.3 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.

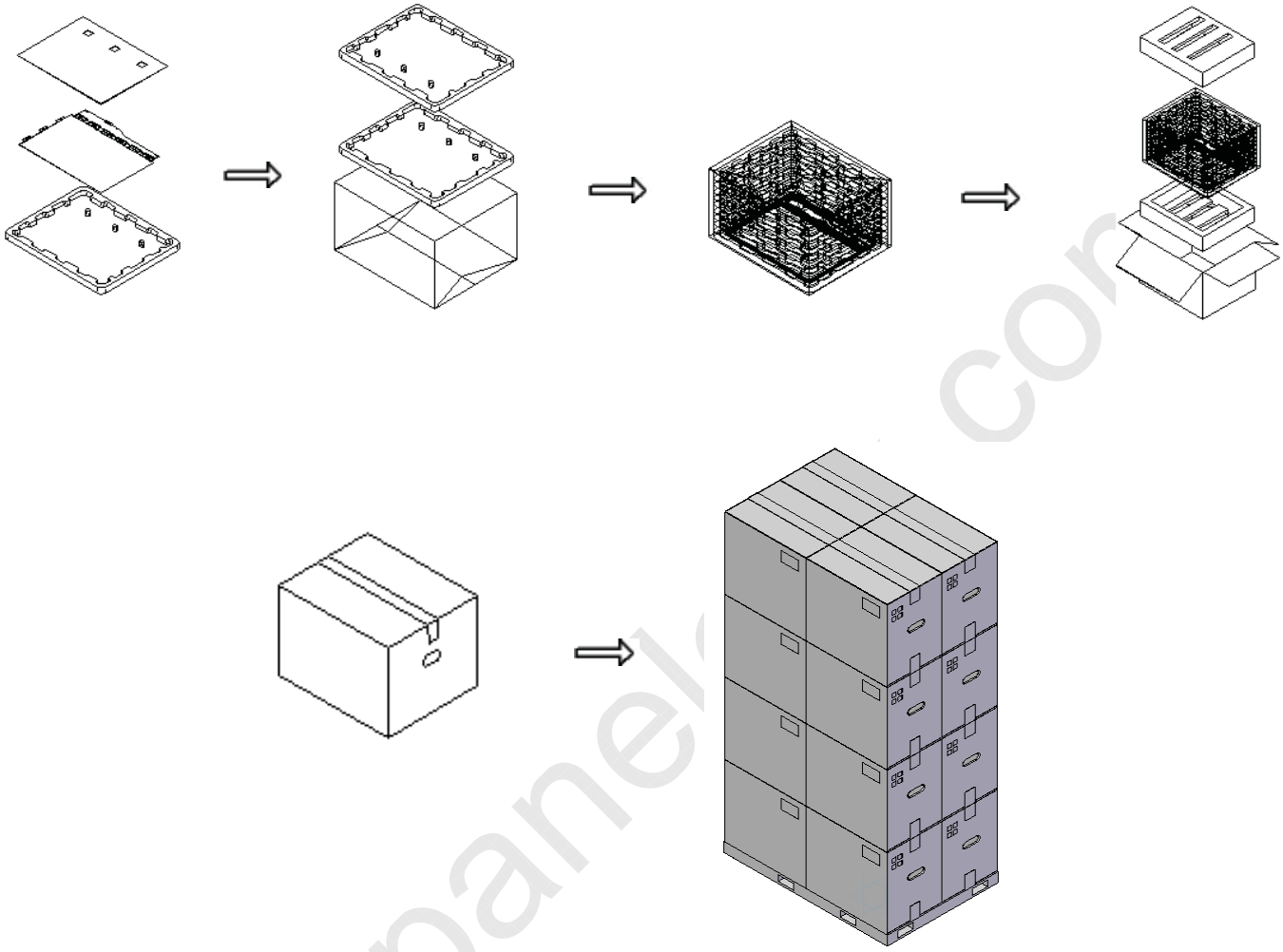
5.4 TRANSPORTATION

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

5.5 SIZE AND WEIGHT FOR PACKING BOX

Parameter	Packing box	Unit
Size	545*475*468	mm
Weight	0.28（type）	kg
Total weight	14.5（type） （with 22 PCS panel）	kg

5.6 OUTLINE FIGURE FOR PACKING



6. PRECAUTIONS

6.1 ASSEMBLY AND HANDLING PRECAUTIONS

1) Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customers deal with the product, because products may be damaged by electrostatic.
2) Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
3) In order to prevent dew condensation occurring by temperature difference, the product packing box must be opened after leave under the environment of an unpacking room temperature enough. Because a situation of dew condensation occurring is changed by the environment temperature and humidity, evaluate the leaving time sufficiently. (Recommendation leaving time: 6 hour or more with packing state)
4) This product is not designed as radiation hardened.
5) To assemble backlight or install module into user's system, it should be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
6) 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, skin or clothes, it has to be washed away thoroughly with soap.
7) It is dangerous that moisture come into or contacted the product, because moisture may damage the product when it is operating.
8) High temperature or humidity may reduce the performance of module. Please store this product within the specified storage condition.
9) When ambient temperature is lower than 10℃ may reduce the display quality. For example, the response time will become slowly.
10) Do not apply rough force such as bending or twisting to the product during assembly.
11) It's not permitted to have pressure or impulse on the module because the LCD panel will be damaged.
12) Do not pull the I/F connector in or out while the module is operating.
13) After the product's end of life, it is not harmful in case of normal operation and storage.

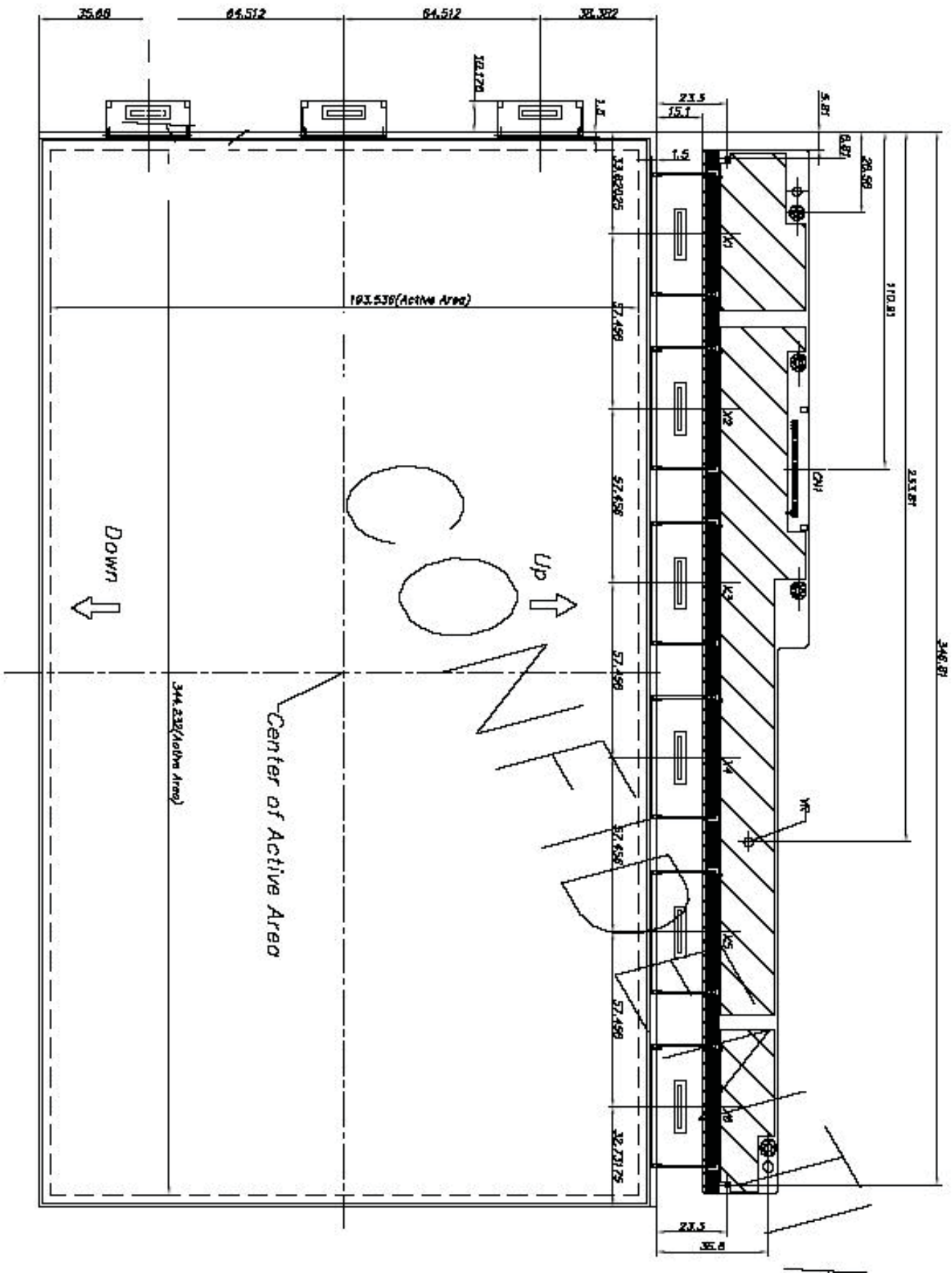
6.2 OTHER

All GND and VCC terminals should be used without a non-connected line.

The following items are neither defects nor failures.

1) Response time, luminance and color may be changed by ambient temperature.
2) The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
3) The interference noise of input signal frequency for this product and luminance control frequency of customer's backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.

7. OUTDRAWING



Rev	Revised date	Main Revision item and sign	Approved by	Checked by	Prepared by	Published date
1.0	2009-12-24	New publication Sign: 质量 赵振理 09/12/25; 营销 娄军 09/12/25	Johnny Joung	Anfernee Du	Xiao Chunjie	2009-12-24
2.0	2010-6-7	Rev 2.0 Sign: 质量; 营销 Note: 1、Add the "Differential input voltage".	Sun Xiaoping	Anfernee Du	Hyman Chen	2010-6-7