

Date: Jun. 02, 2008

TECHNICAL DATA

TX48D21VM0CAA

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RECORD OF REVISION

Date	The upper section : Before revision The lower section : After revision		Summary
	Sheet No.	Page	
Jun.02,2008	TX48D21VM0CAA_1 TX48D21VM0CAA_2	11-2/2,13-All	Changed:DIMENSIONAL OUTLINE Deleted: COSMETIC SPECIFICATIONS

APPLICATION

In the case of applying this product for such as control and safety device of transportation facilities (airplane, train, automobile, ship, etc), equipments aiming for rescue and security, and the other safety related devices which should secure higher reliability and safety, please make it sure that proper countermeasure such as fail-safe functions and enough system design for the protection are mandatory.

Please do not apply this product for equipments or devices which need exceedingly high reliability, such as aerospace applications, telecommunication facilities (trunk lines), nuclear related equipments or plants, and critical life support devices or applications. Usage style of this product is limited to Landscape mode. Optical characteristics mentioned in this spec. sheet is applied for only initial stage after delivery, and the characteristics will be changed by long time usage. Reliability of this product is secured as normal office use.

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DESCRIPTION

The following specifications are applied to the following IPS-Pro-TFT module.

Note : Inverter for back light unit is not built in this module.

General Specifications

Part Name	: TX48D21VM0CAA
Effective Display Area	: H409.50 × V255.9375 [mm]
Number of Pixels	: H1680 × V1050 [pixels]
Pixel Pitch	: H0.24375 × V0.24375 [mm]
Color Pixel Arrangement	: R+G+B Vertical Stripe
Display Mode	: Transmissive Mode Normally Black Mode IPS-Pro
Top Polarizer Type	: Anti-glare
Number of Colors	: 16,777,216 colors
Viewing Angle Range	: Super Wide Version
Input Signal	: 2-channel LVDS (LVDS:Low Voltage Differential Signaling)
Back Light	: 6 pcs. of CCFL
External Dimensions	: H444 × V300 × t24.0 [mm]
Weight	: (Typ. 3,090g)
RoHS	: Compliance

1. ABSOLUTE MAXIMUM RATINGS

1.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

ITEM	Operating		Storage		Unit	Note
	Min.	Max.	Min.	Max.		
Temperature	0	55	-20	60	°C	1)
Humidity	2)		2)		%RH	1)
Vibration	—	4.9 (0.5G)	—	14.7 (1.5G)	m/s ²	3)
Shock	—	29.4 (3G)	—	294 (30G)		4)
Corrosive Gas	Not Acceptable		Not Acceptable		—	—
Illumination at LCD Surface	—	50,000	—	50,000	lx	—

Note 1) Temperature and Humidity should be applied to the center glass surface of a TFT module, not to the system installed with a module.

The temperature at the center of rear surface should be less than 60°C on the condition of operating. Function of module is guaranteed in above operating temperature range, but optical characteristics is specified for only 25°C operating condition.

The brightness of a CCFL tends to drop at low temperature. Besides, the life-time becomes shorter at low temperature.

2) $T_a \leq 40^\circ\text{C}$ Relative humidity should be less than 85%RH max. Dew is prohibited.

$T_a > 40^\circ\text{C}$ Relative humidity should be lower than the moisture of the 85%RH at 40°C.

3) Frequency of the vibration is between 15Hz and 100Hz. (Remove the resonance point)

4) Pulse width of the shock is 10 ms.

1.2 Electrical Absolute Maximum Ratings

(1) TFT Module

V_{SS}=0V

ITEM	SYMBOL	Min.	Max.	Unit	Note
Power Supply Voltage	V _{DD}	0	13.5	V	—
Input Voltage for logic	V _I	-0.3	3.6	V	1)
Electrostatic Durability	V _{ESD0}	±100		V	2),3)
	V _{ESD1}	±8		kV	2),4)

Note 1) It is applied to pixel data signal and clock signal.

2) Discharge Coefficient: 200pF-250Ω, Environmental: 25°C-70%RH

3) It is applied to I/F connector pins.

4) It is applied to the surface of a metallic bezel and a LCD panel.

(2) Back Light

GND=0V

ITEM	SYMBOL	Min.	Max.	Unit	Note
Input Current	I _L	—	(7.5)	mArms	1)
Input Voltage	V _L	—	(1800)	Vrms	2)

Note 1) The specification shall be applied each CCFL. The specification is defined at ground line.

2) The specification shall be applied connector pins for a CCFL at start-UP.

2. OPTICAL CHARACTERISTICS

The following optical characteristics are measured when the LCD is set alone (apart from driving circuits and monitor cabinets) and under stable conditions. It takes about 30 minutes to reach stable conditions. The measuring point is the center of display area otherwise noted.

The optical characteristics should be measured in a dark room or equivalent state.

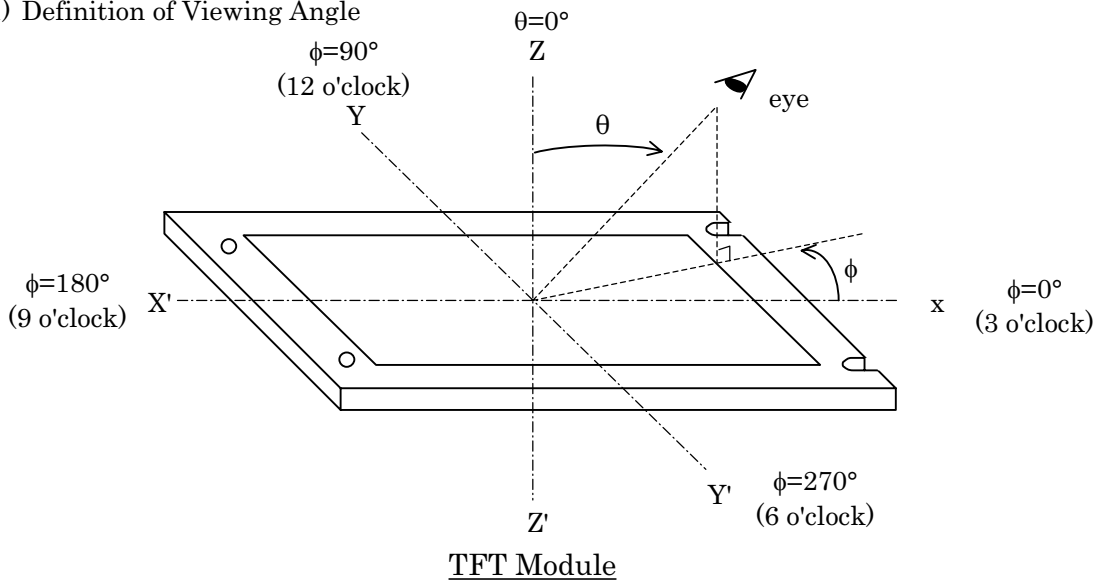
Measuring equipment: CS1000A or CA-210, EZ-contrast

Ta (ambient Temperature)=25°C, VDD=12.0V, fV=60Hz,

IL=6.5mA (average of 6 pieces of CCFLs. PWM Duty 100%)

ITEM		SYMBOL	CONDITION	Min.	Typ.	Max.	UNIT	NOTE
Contrast Ratio		CR	$\theta = 0^\circ$ 1)	500	800	—	—	2)
Response Time	Rise	ton		—	(11)	(19)	ms	3)
	Fall	tof		—	(12)	(20)		
Brightness of white		Bwh		240	300	—	cd/m ²	—
Brightness uniformity		Buni		70	—	—	%	4)
Color Chromaticity (CIE)	Red	x		Typ-0.03	(0.64)	Typ+0.03	—	(Gray scale) 255
		y		Typ-0.03	(0.34)	Typ+0.03		
	Green	x		Typ-0.03	(0.3)	Typ+0.03		
		y		Typ-0.03	(0.59)	Typ+0.03		
	Blue	x		Typ-0.03	(0.14)	Typ+0.03		
		y	Typ-0.03	(0.10)	Typ+0.03			
	White	x	Typ-0.03	0.313	Typ+0.03			
		y	Typ-0.03	0.329	Typ+0.03			
Variation of Color Position (CIE)	Red	Δx	$\theta = +30^\circ$ $\phi = 0^\circ, 90^\circ$ 180°, 270° 1)	—	—	0.04	—	(Gray scale) 255
		Δy		—	—	0.04		
	Green	Δx		—	—	0.04		
		Δy		—	—	0.04		
	Blue	Δx		—	—	0.04		
		Δy		—	—	0.04		
	White	Δx		—	—	0.04		
		Δy		—	—	0.04		
Contrast Ratio at 85°		CR85°	$\theta = \pm 85^\circ$	10	—	—	—	—

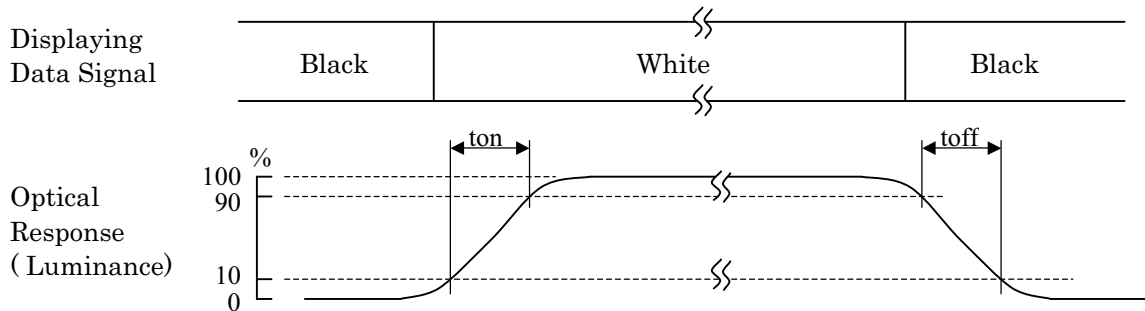
Note 1) Definition of Viewing Angle



2) Definition of Contrast Ratio

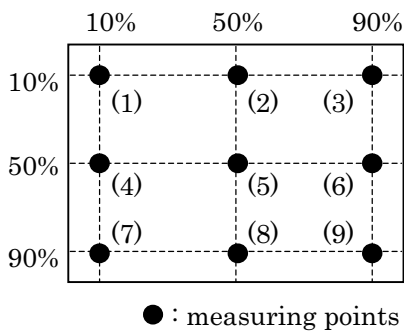
$$CR = \frac{\text{(Luminance at displaying WHITE)}}{\text{(Luminance at displaying BLACK)}}$$

3) Definition of Response Time



* Temperature of LCD surface=30°C

4) Definition of Brightness Uniformity



Display pattern is white (255 level). The brightness uniformity is defined as the following equation. Brightness at each point is measured, and average, maximum and minimum brightness is calculated.

$$Buni = \left(\frac{Bmin}{Bmax} \right) \times 100$$

where, Bmax = Maximum brightness
Bmin = Minimum brightness

5) Variation of color position on CIE is defined as difference between colors at $\theta = 0^\circ$ and at $\theta = 30^\circ$ & $\phi = 0^\circ, 90^\circ, 180^\circ, 270^\circ$.

3. ELECTRICAL CHARACTERISTICS

3.1 TFT-LCD Module

Ta=25°C, Vss=0V

ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	V _{DD}	11.4	12.0	12.6	V	—
Power Supply Current	I _{DD}	TBD.	TBD.	TBD.	mA	1),2),3)
Vsync Frequency	f _V	50	60	60	Hz	4)
Hsync Frequency	f _H	52.7	63.2	66	kHz	—
DCLK Frequency	f _{CLK}	51.7	62	69.3	MHz	—

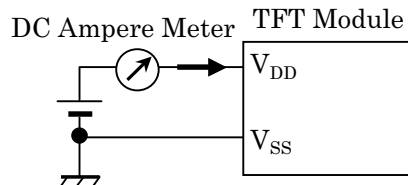
Dimensions in parentheses are reference value.

* The LCD panel works ordinarily when f_v is set between 60Hz.

However, picture quality and optical characteristics can be guaranteed only at f_v=60Hz.

If the LCD is used other than f_v=60Hz, customers are requested to check picture quality of the LCD under customers' specific conditions.

Note 1) DC current at f_v=60.0Hz, f_{CLK}=62MHz and V_{DD}=12.0V



2) Current capacity of power supply for V_{DD} should be larger than 5A, so that the fuse can be opened at the trouble of power supply.

3) The picture on maximum current is white picture.

4) When at low frequency drive, flicker may appear on screen. Therefore, please verify the flicker level before system design.

3.2 Back Light

Ta=25°C

ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Note
Input Current	I _L	(3.0)	6.5	(7.0)	mArms	1),2),7),8),9)
Input Voltage	V _L	—	(770)	—	V _{rms}	8),10)
Frequency	f _L	(40)	(54)	(65)	kHz	3)
Kick-Off Voltage	V _s	(1580)	—	(1750)	V _{rms}	4),5)

Notes 1) The specification shall be applied to each CCFL. The specification is defined at ground line.

2) Higher I_L causes the short life time of CCFL.

3) Lighting frequency for a CCFL may cause the interference with scanning frequency and cause beat or flicker on the display. Therefore, Lighting frequency shall be as different as possible from scanning frequency in order to avoid the interference.

4) Starting Lamp Voltage should be more than V_s (Min.).

5) Ta=0°C

6) The difference of surface temperature of any single CCFL should be less than 5 deg.C.

7) When the lighting wave form of the inverter is asymmetry, the inclination of mercury is generated. Therefore, please adjust the imbalance factor (|IP-I-P|/I_{rms}×100) of the lighting current wave form is less than 8%, and adjust the crest factor (IP (or I-P)/I_{rms}) to 1.414 8%.

8) Input current and voltage wave form of every CCFL should be synchronized.

9) Inverter for CCFL should not produce too much leakage current.

10) CCFL's are recommended to connect ballast condenser at the high voltage output side of inverter.

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4. BLOCK DIAGRAM

(1) TFT Module

LVDS (ODD data)

Timing signals

Display data

Control signals

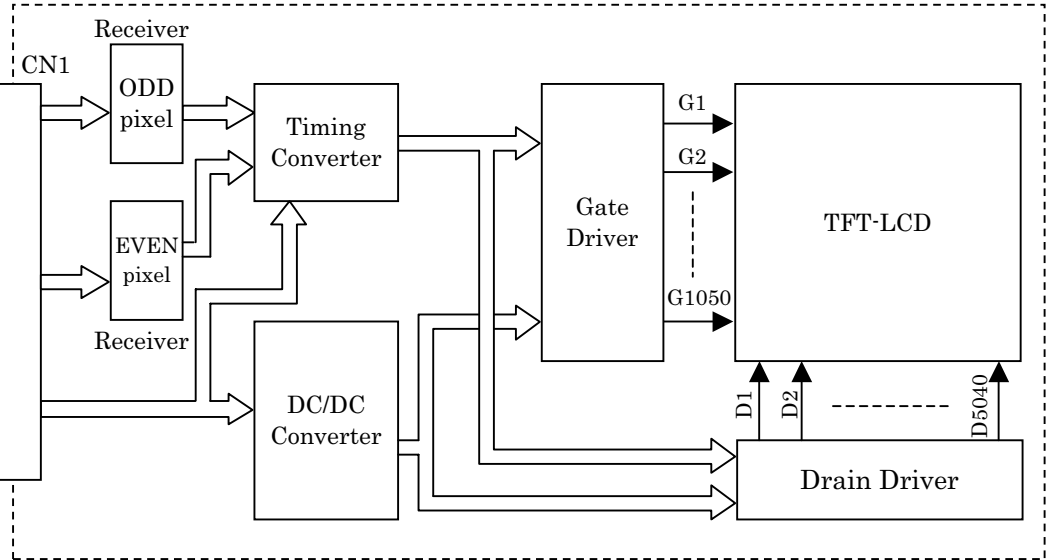
LVDS (EVEN data)

Timing signals

Display data

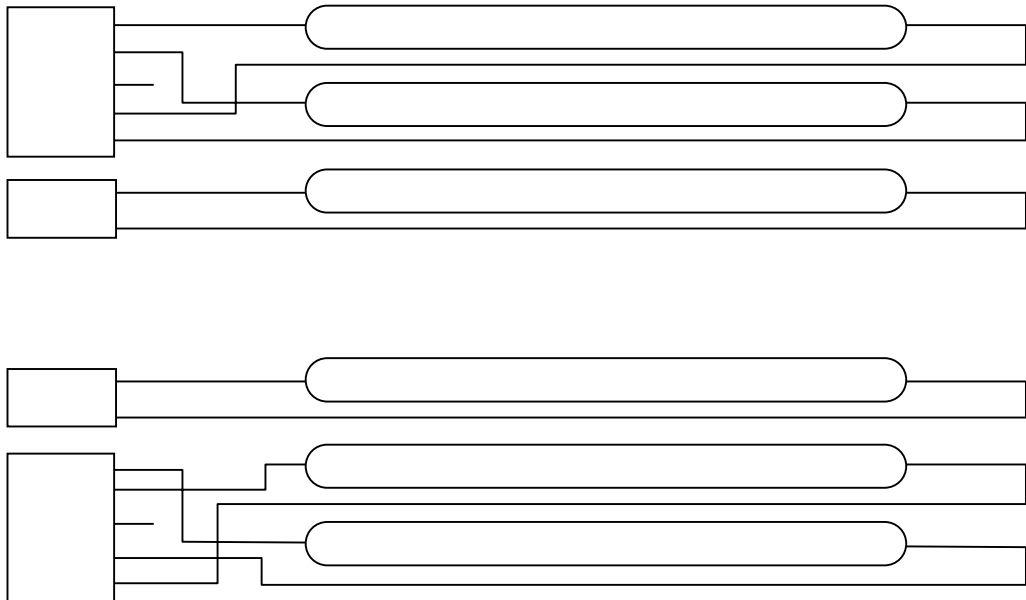
Control signals

DC power supply



(2) Back light unit

Up Side



5. INTERFACE PIN ASSIGNMENT

5.1 TFT-LCD MODULE

CN1 <<HIROSE: MDF76GW-30S-1H>>

Pin No.	Symbol	Function	Note
1	RAIN0-	ODD pixel data	2)
2	RAIN0+		
3	RAIN1-	ODD pixel data	2)
4	RAIN1+		
5	RAIN2-	ODD pixel data	2)
6	RAIN2+		
7	V _{SS}	GND (0V)	1)
8	RACLKIN-	ODD pixel data	2)
9	RACLKIN+		
10	RAIN3-	ODD pixel data	2)
11	RAIN3+		
12	RBIN0-	EVEN pixel data	2)
13	RBIN0+		
14	V _{SS}	GND (0V)	1)
15	RBIN1-	EVEN pixel data	2)
16	RBIN1+		
17	V _{SS}	GND (0V)	1)
18	RBIN2-	EVEN pixel data	2)
19	RBIN2+		
20	RBCLKIN-	EVEN pixel data	2)
21	RBCLKIN+		
22	RBIN3-	EVEN pixel data	2)
23	RBIN3+		
24	V _{SS}	GND (0V)	1)
25	NC	No connection	3)
26	NC	No connection	3)
27	NC	No connection	3)
28	V _{DD}	Power supply (+12.0V)	4)
29	V _{DD}		
30	V _{DD}		

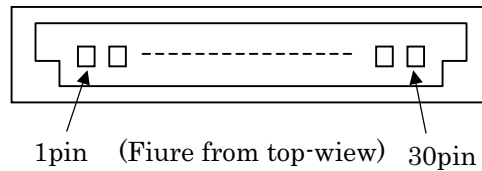
Note 1) All Vss pins should be grounded.

2) RnINm+ and RnINm- (n=A,B m=0,1,2,3) should be wired by twist-pairs or side-by-side FPC patterns, respectively.

3) Please keep open.

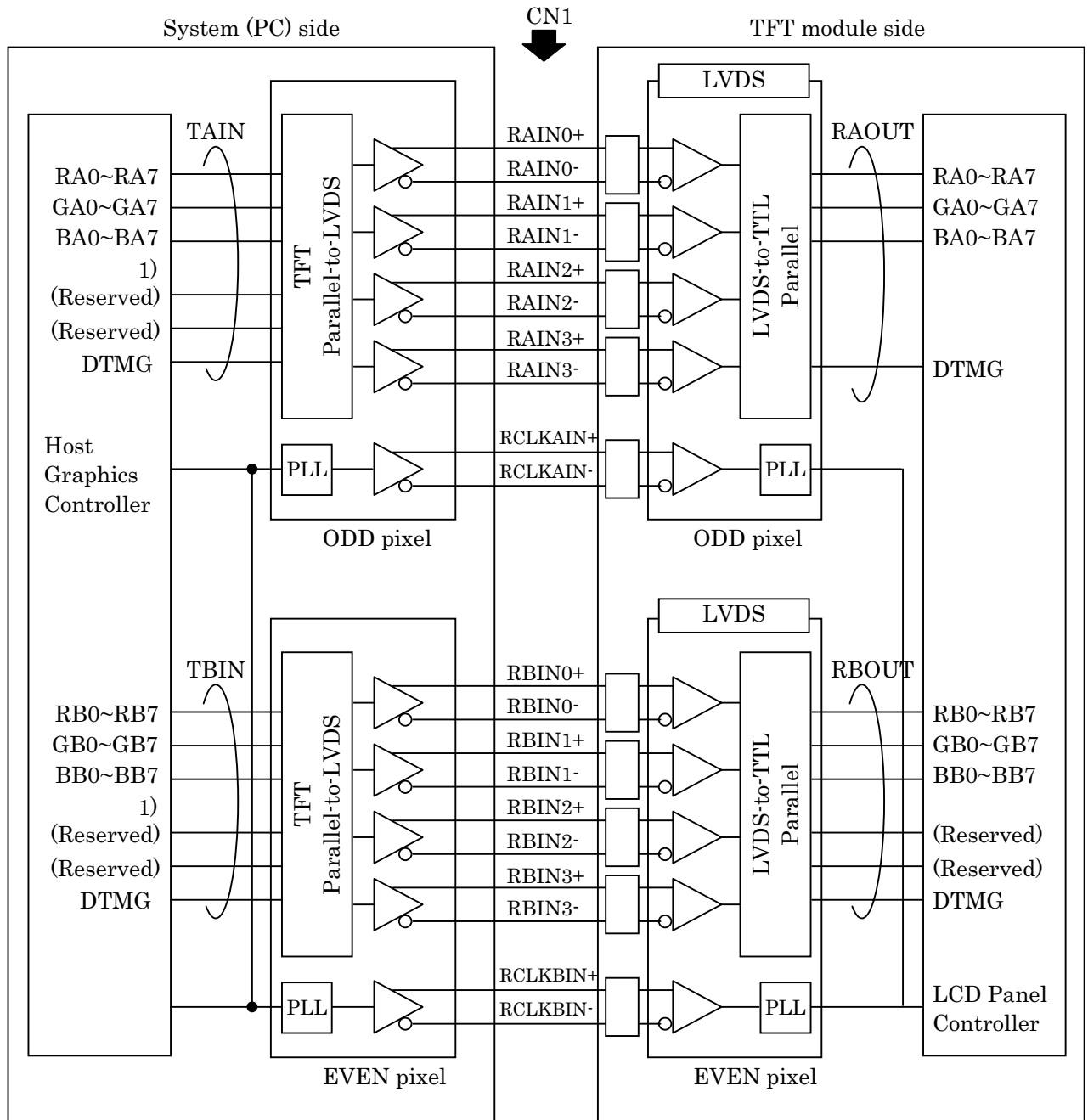
4) All VDD pins should be connected to +12.0 V(typ.).

5) Pin assignment is as follows.



5.2 BACK-LIGHT UNIT

BLOCK DIAGRAM OF INTERFACE



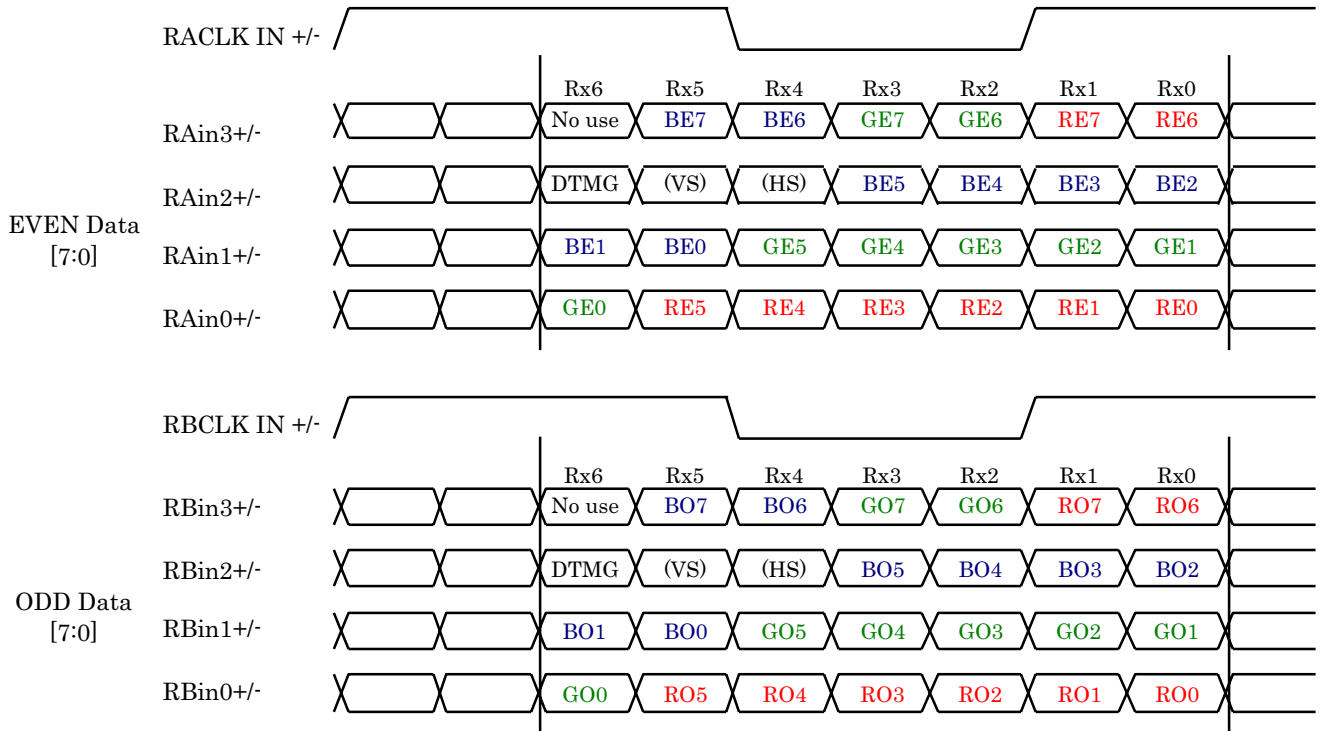
RA0~7, RB0~7 : R data
 GA0~7, GB0~7 : G data
 BA0~7, BB0~7 : B data
 DTMG : Display timing data

Receiver: Equivalent of THC63LVDF84B by Thine

- Note 1) RSVD (reserved) pins on a transmitter should be connected with Vss.
- 2) The system must have a LVDS transmitter to drive a module.
Moreover, each channel must have a DTMG signal.
- 3) The impedance of LVDS cable should be 50 ohms per a signal line or about 100 ohms per a twist-pair line when it is used differentially.

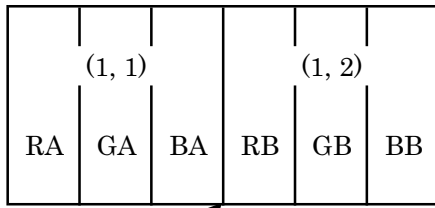
LVDS INTERFACE

8bit Digital



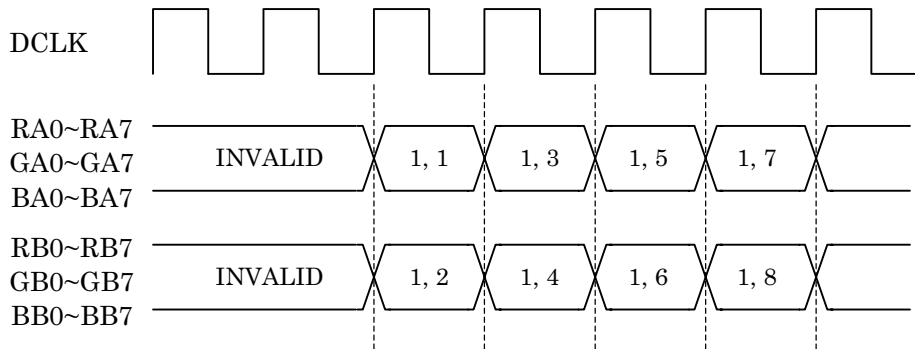
8 bit x 3 LVDS Interface Format

CORRESPONDENCE BETWEEN INPUT DATA AND DISPLAY IMAGE



ODD pixel: RA0~RA7 : R data
 GA0~GA7 : G data
 BA0~BA7 : B data
 EVEN pixel: RB0~RB7 : R data
 GB0~GB7 : G data
 BB0~BB7 : B data

1, 1	1, 2	1, 3	1, 1680
2, 1	2, 2	2, 3	2, 1680
3, 1	3, 2	3, 3	3, 1680
⋮	⋮	⋮		⋮
1050, 1	1050, 2	1050, 3	1050, 1680



RELATIONSHIP BETWEEN DISPLAY COLORS AND INPUT SIGNALS

Input data		R data								G data								B data							
		RA7	RA6	RA5	RA4	RA3	RA2	RA1	RA0	GA7	GA6	GA5	GA4	GA3	GA2	GA1	GA0	BA7	BA6	BA5	BA4	BA3	BA2	BA1	BA0
Color		RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0	BB7	BB6	BB5	BB4	BB3	BB2	BB1	BB0
		MSB				LSB				MSB				LSB				MSB				LSB			
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
	Red (255)	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 (255)	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 (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	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
	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
	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	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
	Red (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Red (254)	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 (255)	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	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
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Green (254)	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 (255)	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	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 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	Blue (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1

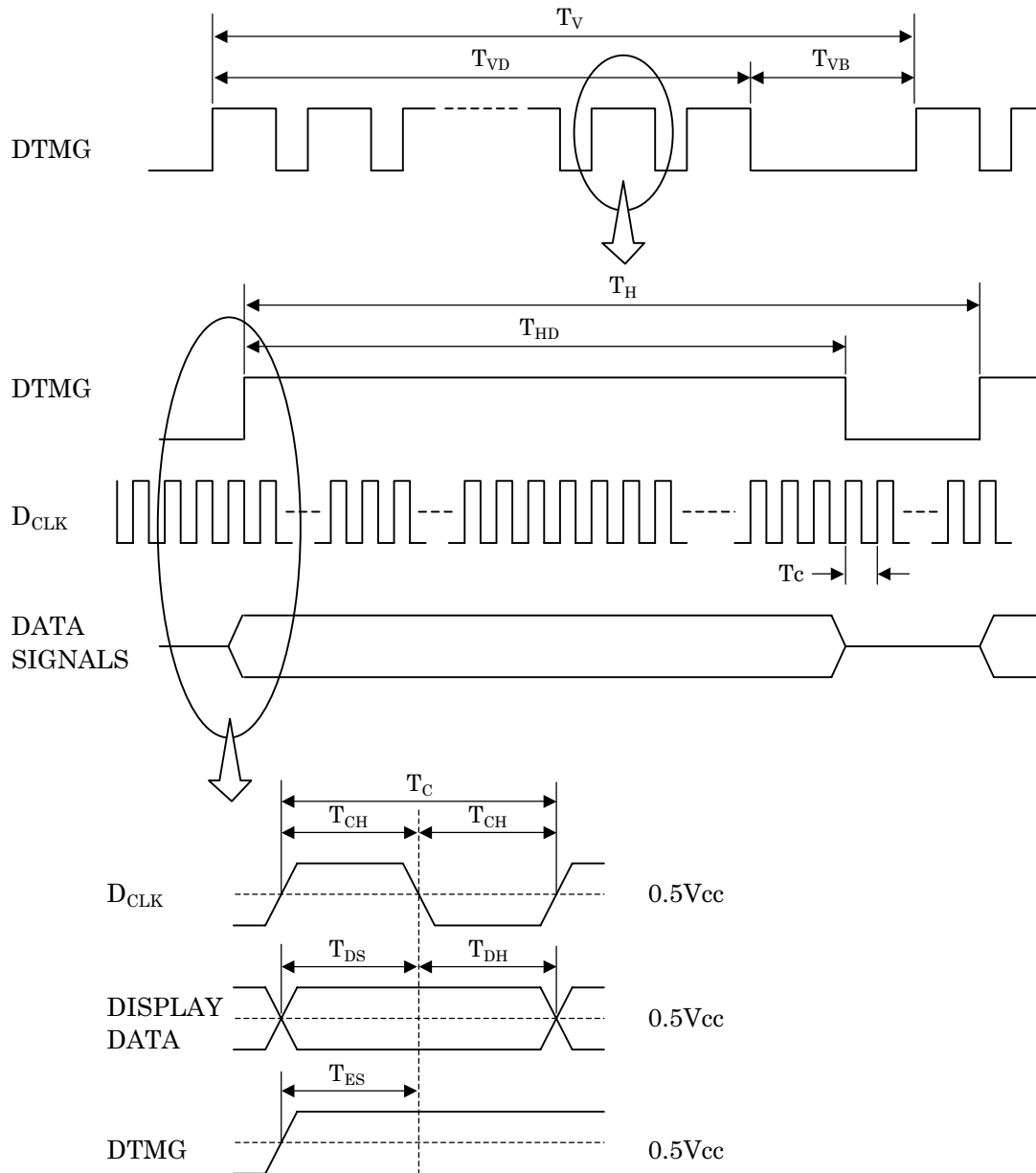
Note 1) Definition of gray scale: Color (n)

2) n indicates gray scale level. Higher n means brighter level.

Data signals: 1: High, 0: Low

6. TIMING DIAGRAMS OF INTERFACE TIMING

6.1 Timing diagrams of interface signal



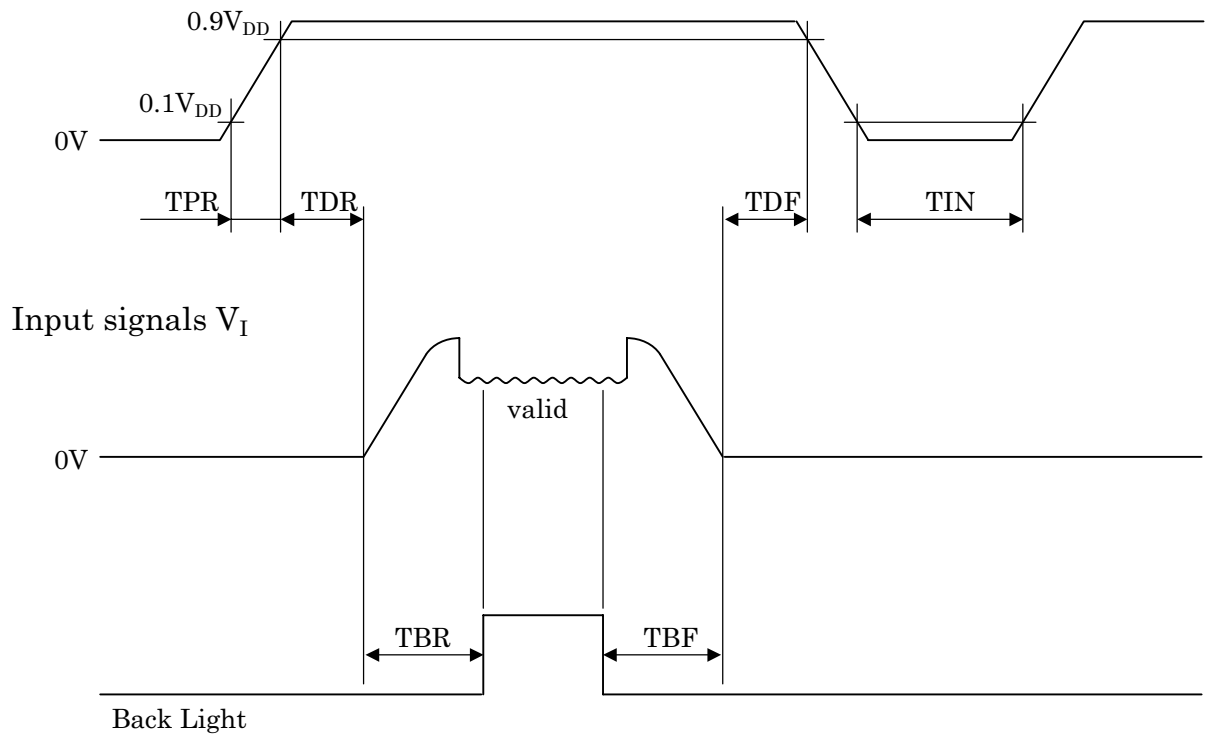
6.2 Timing Parameters

SIGNAL	ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	1/Tc	51.7	62.0	69.3	MHz	
Frame Frequency	Cycle	t_V	16.7	16.7	20.0	msec	
			1,054	1,054	1,100	lines	—
Vertical Active Display Term	Display Period	t_{VD}	1,050	1,050	1,050	lines	—
	Vertical Blank Period	t_{VB}	4	4	50	lines	—
One Line Scanning Time	Cycle	t_H	980	980	1,050	clocks	—
Horizontal Active Display Term	Display Period	t_{HD}	840	840	840	clocks	—

Dimensions in parentheses are reference value.

6.3 TIMING BETWEEN INTERFACE SIGNALS AND POWER SUPPLY

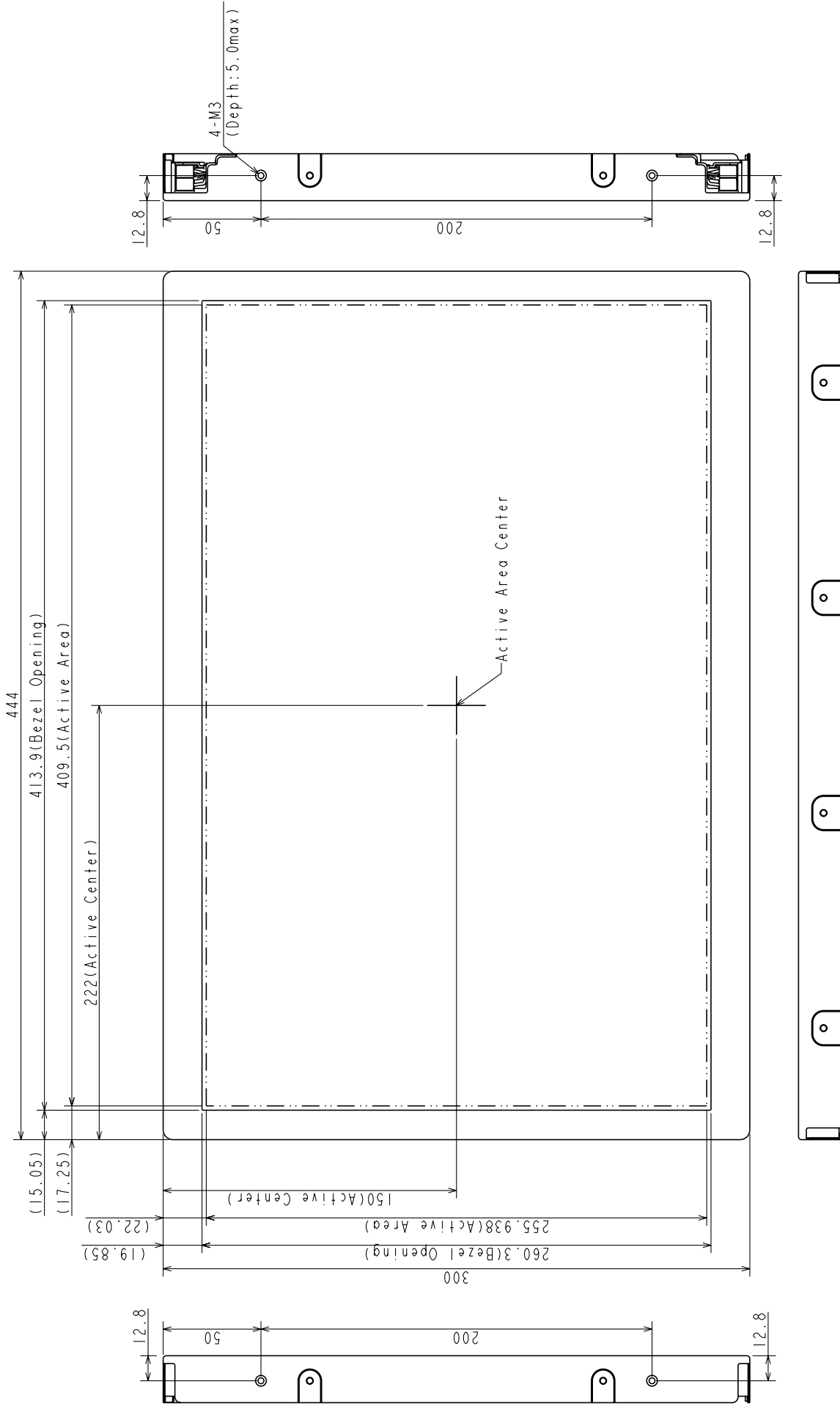
Power supply voltage V_{DD}



Timing of power supply voltage and input signals should be used under the following specifications.

$$\begin{aligned}
 0\text{ms} &\leq \text{TPR} \leq 10\text{ms} \\
 10\text{ms} &\leq \text{TDR} \leq 50\text{ms} \\
 0\text{ms} &\leq \text{TDF} \leq 50\text{ms} \\
 \text{TIN} &\geq 1\text{s} \\
 \text{TBR} &\geq 500\text{ms} \\
 \text{TBF} &\geq 100\text{ms}
 \end{aligned}$$

Dimensional Outline
(1) Front View

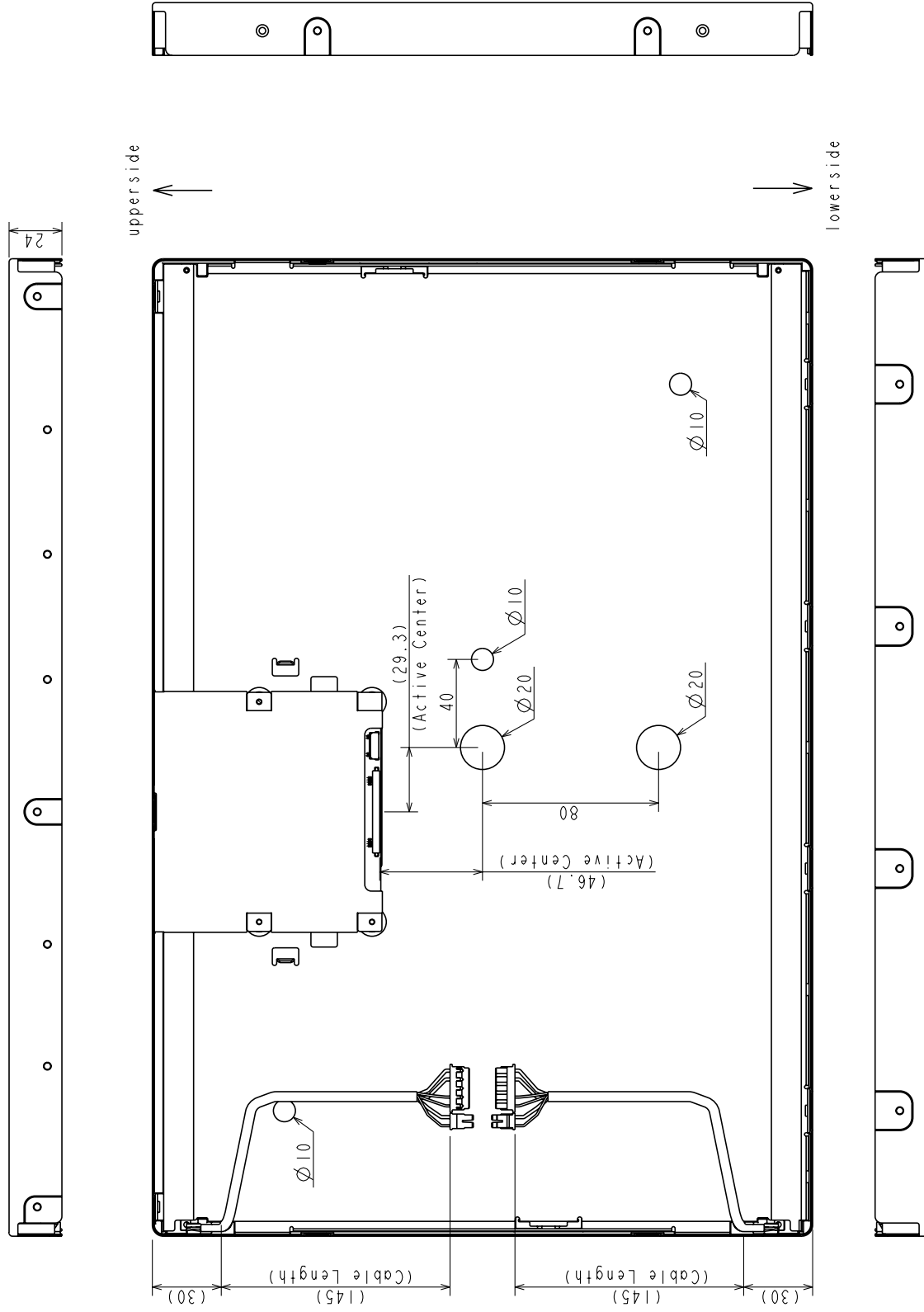


Unit : mm
Scale : NTS

- Note 1) The dimension in parentheses are reference value.
 2) Unspecified tolerance to be ± 0.5 .
 3) Measure the thickness with 9.8x10 Pa(1.0kgf/cm) Precaure.
 4) Maximum torque for the screw in mounting module: 0.392N·m.

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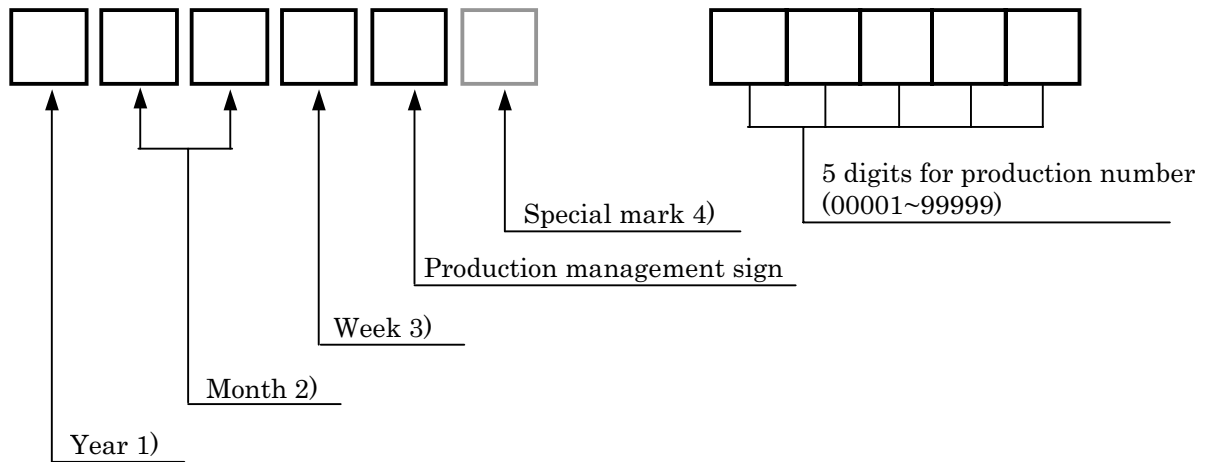
(2) Back View



Unit : mm
Scale : NTS

8. DESIGNATION OF LOT MARK

8.1 LOT MARK



Notes

1)

Year	Mark
2008	8
2009	9
2010	0
2011	1
2012	2

2)

Month	Mark	Month	Mark
1	01	7	07
2	02	8	08
3	03	9	09
4	04	10	10
5	05	11	11
6	06	12	12

3)

Week (Days)	Mark
1~7	1
8~14	2
15~21	3
22~28	4
29~31	5

4) It is the mark that was opened up by production person to take correspondence with production number.

8.2 Revision (REV.) control

REV. is the column for manufacturing convenience. A-Z except I and O may be written on this column.

8.3 Location of lot mark

Lot mark is printed on a label. The label is on the metallic bezel as shown in 7. External Dimensional. The style of character will be changed without notice.

10. PRECAUTION

Please pay attention to the followings when a TFT module with a back-light unit is used, handled and mounted.

10.1 PRECAUTION TO HANDLING AND MOUNTING

- (1) Applying strong force to a part of the module may cause partial deformation of frame or mold, and cause damage to the display.
- (2) The module should gently and firmly be held by both hands. Never hold by just one hand in order to avoid any internal damage. Never drop or hit the module.
- (3) The module should be installed with mounting holes of a module.
- (4) Uneven force such as twisted stress should not be applied to a module when a module is mounted on the cover case. The cover case must have sufficient strength so that external force can not be transmitted directly to a module.
- (5) It is recommended to leave a space between a module and a holding board of a module so that partial force is not applied to a module.

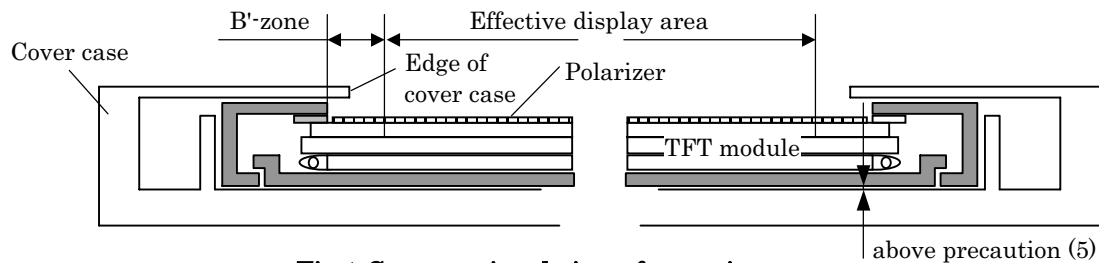


Fig.1 Cross sectional view of a monitor set

- (6) The edge of a cover case should be located inside more than 1mm from the edge of a module front frame.
- (7) Materials included acetic acid and chlorine should not be used for a cover case as well as other parts and boards near a module. Acetic acid attacks a polarizer. Chlorine attacks electric circuits due to electro-chemical reaction.
- (8) The polarizer on a TFT cell should carefully be handled due to its softness, and should not be touched, pushed or rubbed with glass, tweezers or anything harder than HB pencil lead. The surface of a polarizer should not be touched and rubbed with bare hand, greasy clothes or dusty clothes.
- (9) The surface of a polarizer should be gently wiped with absorbent cotton, chamois or other soft materials slightly contained petroleum benzene when the surface becomes dirty. Isopropyl alcohol as cleaning chemicals is recommended in order to clean adhesives which fix front/rear polarizers on a TFT cell. Other cleaning chemicals such as acetone, toluene and Normal-hexane should not be used to clean adhesives because they cause chemical damage to a polarizer.
- (10) Saliva or water drops should be immediately wiped off. Otherwise, the portion of a polarizer may be deformed and its color may be faded.
- (11) The module should not be opened or modified. It may cause not to operate properly. If the module is once opened or modified, warranty of the module becomes invalid and Hitachi doesn't guarantee its quality and reliability.
- (12) Metallic bezel of a module should not be handled with bare hand or dirty gloves. Otherwise, color of a metallic frame may become dirty during its storage. It is recommended to use clean soft gloves and clean finger stalls when a module is handled at incoming inspection process and production (assembly) process.
- (13) Lamp (CCFL) cables should not be pulled and held.

10.2 PRECAUTION TO OPERATION

- (1) The ambient temperature near the operated module should be satisfied with the absolute maximum ratings. Unless it meets the specifications, sufficient cooling system should be adopted to system.
- (2) The spike noise causes the miss-operation of a module. The level of spike noise should be as follows: $-200\text{mV} \leq \text{over- and under- shoot of VDD} \leq +200\text{mV}$
VDD including over- and under- shoot should be satisfied with the absolute maximum ratings.
- (3) Optical response time, luminance and chromaticity depend on the temperature of a TFT module. Response time and saturation time of CCFL luminance become longer at lower temperature operation.
- (4) Sudden temperature change may cause dew on and/or in the a module. Dew males damage to a polarizer and/or electrical contacting portion. Dew causes fading of displayed quality.
- (5) Fixed patterns displayed on a module for a long time may cause after-image. It will be recovered soon.
- (6) A module has high frequency circuits. Sufficient suppression to electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be effective to minimize the interference.
- (7) Noise may be heard when a back-light is operated. If necessary, sufficient suppression should be done by system manufacturers.
- (8) The module should not be connected or removed while a main system works.

10.3 ELECTROSTATIC DISCHARGE CONTROL

- (1) Since a module consists of a TFT cell and electronic circuits with CMOS-ICs, which are very weak to electrostatic discharge, persons who are handling a module should be grounded through adequate methods such as a list band. I/F connector pins should not be touched directly with bare hands.
- (2) Protection film for a polarizer on a module should be slowly peeled off so that the electrostatic charge can be minimized.

10.4 PRECAUTION TO STRONG LIGHT EXPOSURE

- (1) A module should not be exposed under strong light. Otherwise, characteristics of a polarizer and color filter in a module may be degraded.

10.5 PRECAUTION TO STORAGE, PACKAGE AND TRANSPORTATION

When modules for replacement are stored for a long time, following precautions should be taken care of :

- (1) Modules should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during storage. Modules should be stored at 5 to 35°C at normal humidity (60%RH or less).
- (2) The surface of polarizers should not come in contact with any other object. It is recommended that modules should be stored in the Hitachi's shipping box.
- (3) The module should not be transported when display side was downward.
It causes the breakdown of the module.

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10.6 PRECAUTION TO HANDLING PROTECTION FILM

- (1) The protection film for polarizers should be peeled off slowly and carefully by persons who are electrically grounded with adequate methods such as a list band. Besides, ionized air should be blown over during peeling action. Dusts on a polarizer should be blown off by an ionized nitrogen gun and so on.
- (2) The protection film should be peeling off without rubbing it to the polarizer. Because, if the film is rubbed together with the polarizer, since the film is attached to the polarizer with a small amount of adhesive, the adhesive may remain on a polarizer.
- (3) The module with protection film should be stored on the conditions explained in 10.5 (1). However, in case that the storage time is too long, adhesive may remain on a polarizer even after a protection film is peeled off. Besides, in case that a module is stored at higher temperature and/or higher humidity, adhesive may remain on a polarizer. The remained adhesive may cause non-uniformity of display image.
- (4) The adhesive can be removed easily with Isopropyl alcohol. The remained adhesive or its vestige on the polarizer should be wiped off with absorbent cotton or other soft materials such as chamois slightly contained Isopropyl alcohol.

10.7 SAFETY

- (1) Since a TFT cell and lamps are made of glass, handling to the broken module should be taken care sufficiently in order not to be injured. Hands touched liquid crystal from a broken cell should be washed sufficiently.
- (2) The module should not be taken apart during operation so that back-light drives by high voltage.
- (3) Inverter for driving CCFL should have over current/voltage detect circuit in case back-light failure happens. Also protection circuit (open,short,spark,etc) should be verified on inverter and system side.

10.8 ENVIRONMENTAL PROTECTION

- (1) The TFT module contains cold cathode fluorescent lamps. Please follow local ordinance or regulations for its disposal.
- (2) Flexible circuits board and printed circuits board used in a module contain small amount of lead. Please follow local ordinance or regulations for its disposal.

10.9 USE RESTRICTIONS AND LIMITATIONS

- (1) This product is not authorized for use in life support devices or systems, military applications or other applications which pose a significant risk of personal injury.
- (2) In no event shall Hitachi Displays, Ltd., be liable for any incidental, indirect or consequential damages in connection with the installation or use of this product, even if informed of the possibility thereof in advance. These limitations apply to all causes of action in the aggregate, including without limitation breach of contract, breach of warranty, negligence, strict liability, misrepresentation and other torts.

10.10 OTHERS

- (1) Electrical components which may not affect electrical performance are subjective to change without notice because of their availability.
- (2) Limited current circuit must be required for the inverter output.

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