

HITACHI

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FOR MESSRS : _____

DATE : Dec.19,2007

CUSTOMER'S ACCEPTANCE SPECIFICATIONS TX23D12VM0CAA CONTENTS

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*When product will be discontinued, customer will be informed by HITACHI with twelve months prior announcement.

ACCEPTED BY; _____

PROPOSED BY; Elton Liu

RECORD OF REVISION

DATE	SHEET No.	SUMMARY
Nov.09,'06	7B64PS 2704- TX23D12VM0CAA-2 Page-1/1	Revised: 4.1 ENVIROMENTAL ABSOLUTE MAXIMUM RATINGS OPERATING Temperature MIN 0 → (-20),MAX 50 → (70) STORAGE Temperature MAX 65 → 70 Added : Note 5
Dec.19,'07	7B64PS 2704- TX23D12VM0CAA-3 Page-1/1	4.1 ENVIROMENTAL ABSOLUTE MAXIMUM RATINGS Revised : Operating Temperature MIN (-20) → -10 , MAX (70) → 55 Note 5) For operating condition Ta at -20°C < 48h, at 70°C < 100h. ↓ For operating condition Ta at -10°C < 48h, at 55°C < 100h.

3. GENERAL DATA

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

Note : Inverter for Back-Light unit is not built in this module.

Product Name	TX23D12VM0CAA	
Effective Display Area	(H)195.0 x (V)117.0	[mm]
Number of Pixels	(H)800 x (V)480	[pixels]
Pixel Pitch	(H)0.24375 x (V)0.24375	[mm]
Color Pixel Arrangement	R+G+B Vertical Stripe	
Display Mode	Transmissive Mode Normally Black Mode	
Top Polarizer Type	Anti-Glare	
Number of Colors	262,144	[colors]
Viewing Angle Range	Super Wide Version (Horizontal & Vertical : 170° , CR \geq 10)	
Color Gamut	60%(typ.) For NTSC	
Input Signal	CMOS	
Backlight	CCFL ,1 pc Side-light type (U shape)	
External Dimensions	(H)236.0 x (V)135.0 x (t)12.5 typ.	[mm]
Weight	390 typ.	[g]

4. ABSOLUTE MAXIMUM RATINGS

4.1 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	OPERATING		STORAGE		UNIT	NOTE
	MIN.	MAX.	MIN.	MAX.		
Temperature	-10	55	-25	70	°C	1),5)
Humidity	(Note 2)		(Note 2)		%RH	1)
Vibration	-	4.9(0.5G)	-	14.7(1.5G)	m/s ²	3)
Shock	-	29.4(3G)	-	294(30G)	m/s ²	4)
Corrosive Gas	Not Acceptable		Not Acceptable		-	
Illumination at LCD Surface	-	50,000	-	50,000	lx	

Note 1) Temperature and Humidity shall be applied to the glass surface of a IPS-TFT Module, not to the system installed with a module.

The temperature at the lower right of rear surface (nearby the terminal of the CCFL) should be less than 80°C on the condition of operating.

Operating temperature means the temperature a TFT-LCD Module can be driven, the screen performance (contrast, brightness, response time etc.) is judged at Ta=25°C. The brightness of a CCFL tends to drop at low temperature.

Besides, the life-time becomes shorter at low temperature.

2) Ta ≤ 40°C Relative humidity should be less than 85%RH max. Dew is prohibited.

Ta > 40°C Relative humidity should be lower than the moisture of the 85%RH at 40°C

3) Frequency of the vibration is between 20Hz and 50Hz.
(Remove the resonance point)

4) Pulse width of the shock is 10 ms.

5) For storage condition Ta at -25°C < 48h, at 70°C < 100h.

For operating condition Ta at -10°C < 48h, at 55°C < 100h.

4.2 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

4.2.1 IPS-TFT MODULE

VSS=0V

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	VDD	0	4.0	V	
Input Voltage for logic	VI	-0.3	VDD+0.3	V	1)
Electrostatic Durability	VESD0	±100		V	2),3)
	VESD1	±8		kV	2),4)

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

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

3) It shall be applied to I/F connector pins.

4) It shall be applied to the surface of a metallic bezel a LCD panel.

4.2.2 BACK-LIGHT

GND=0V

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Input Current	IL	-	7.0	mArms	1)
Input Voltage	VL	-	2000	Vrms	2)

Note 1) It is defined at ground line.

2) It shall be applied at connector pins for a CFL at start-up.

5. OPTICAL CHARACTERISTICS

The following optical characteristics are measured under stable conditions. It takes about 30 minutes to reach stable conditions. The measuring point is the center of display area unless otherwise noted.

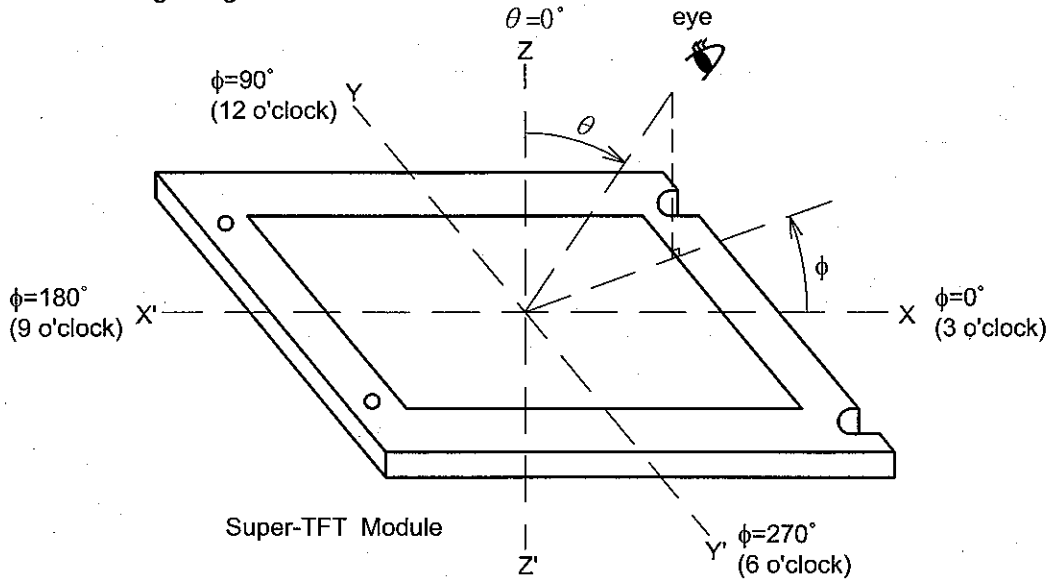
The optical characteristics should be measured in a dark room or equivalent state.

Measuring equipment : Top com BM-7 , ritchard 1980A, or equivalent

Temperature = 25°C , VDD=3.3V , fV=60Hz , IL=(6.0)mArms

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio		CR	$\theta=0^\circ$ (Note 1)	200	400	-	-	2)
Response Time	RISE	ton		-	13	30	ms	3)
	FALL	toff		-	17	35	ms	3)
Brightness of White		Bwh		250	300	-	cd/m ²	
Brightness Uniformity		Buni		70	-	-	%	4)
Color Chromaticity (CIE)	Red	x		0.57	0.62	0.67	-	
		y		0.29	0.34	0.39		
	Green	x		0.24	0.29	0.34		
		y		0.55	0.60	0.65		
	Blue	x		0.09	0.14	0.19		
		y	0.05	0.10	0.15			
	White	x	0.26	0.31	0.36			
		y	0.28	0.33	0.38			
Viewing Angle (CR \geq 10)	x - x'	θ_x	$\phi=0^\circ$	85	-	-	deg.	
		$\theta_{x'}$	$\phi=180^\circ$	85	-	-		
	y - y'	θ_y	$\phi=90^\circ$	85	-	-		
		$\theta_{y'}$	$\phi=270^\circ$	85	-	-		

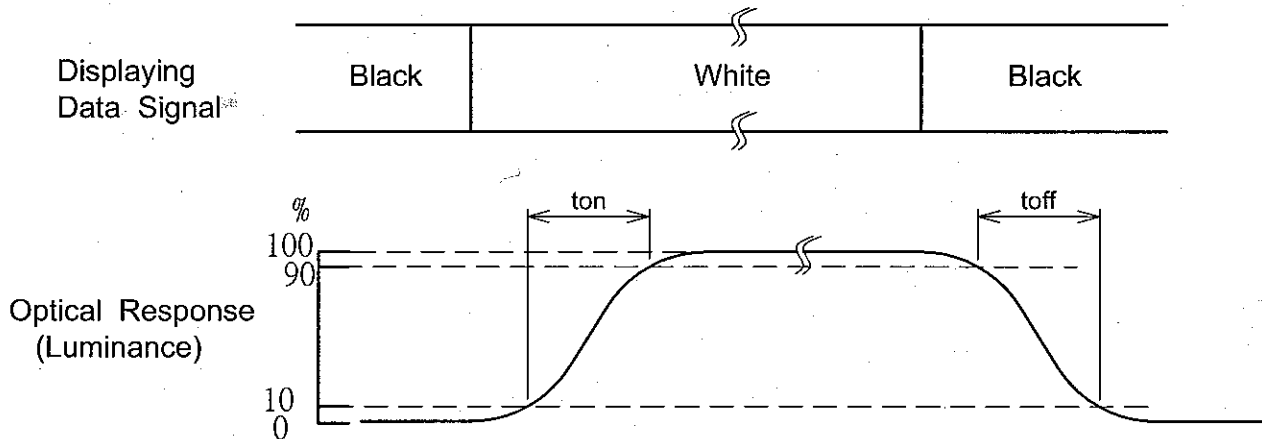
Note 1) Definition of Viewing Angle



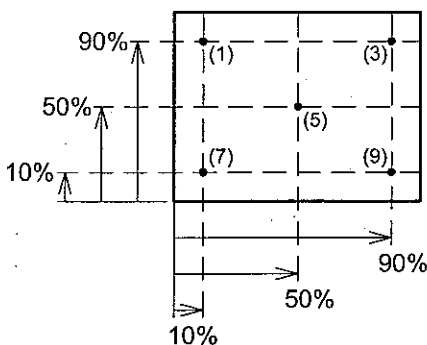
2) Definition of Contrast Ratio(CR):

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

3) Definition of Response Time



4) Definition of Brightness Uniformity



• : measuring point

Display pattern is white (63 level). The brightness uniformity is defined as the following equation. Brightness at each point is measured, and average, maximum and minimum brightness is calculated.

$$Buni = \frac{Bmin}{Bmax} \times 100$$

6. ELECTRICAL CHARACTERISTICS

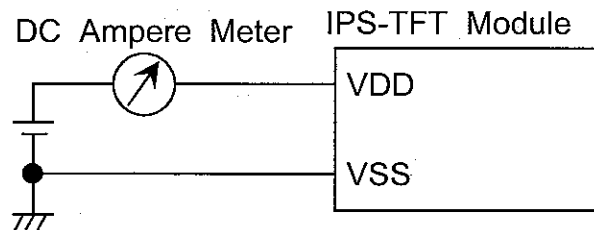
6.1 TFT-LCD MODULE

Ta=25°C , VSS=0V

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage	VDD	3.15	3.3	3.45	V	
Input Voltage for Logic	Hi	V _{IH}	0.8 x VDD	-	V	1)
	Lo	V _{IL}	VSS	-		
Power Supply Current	I _{DD}	-	300	500	mA	2)
Vsync Frequency	f _V	-	60	75	Hz	
Hsync Frequency	f _H	-	31.6	39.2	kHz	
DCLK Frequency	f _{CLK}	-	33.3	40	MHz	

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

2) DC current at f_v=60.0Hz , f_{CLK}=33.3MHz , VDD=3.3V and display pattern is white.



3) Current capacity for power supply VDD should be larger than 3A.
This TFT-LCD Module has a fuse 1A.

6.2 BACK LIGHT

Ta=25°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Lamp Current	I _L	4.0	6.0	7.0	mArms	1),3)
Lamp Voltage	V _L	-	(1000)	-	V _{rms}	
Frequency	f _L	50	-	70	kHz	2)
Starting Lamp Voltage	V _S	1400	-	-	V _{rms}	6)
		1600	-	-		6),7)

Note 1) Higher I_L causes short life time of CCFL.

2) Lamp frequency may cause interference with HSYNC frequency , causing beat or flicker on the display.

Therefore lamp frequency shall be as different as possible from HSYNC frequency in order to avoid the interference.

3) It is defined at GND line.

4) The output voltage of the inverter should be kept 1 sec at least.

Otherwise the lamp may not be turned on.

5) The power supply characteristics of the inverter are very important to the performance of the back light , for example lighting characteristics or life time.

Please evaluate the power supply matching with the back light by the set which is Near to the actual systems sufficiently , in order to avoid the abnormal lighting (flicker , mislighting etc).

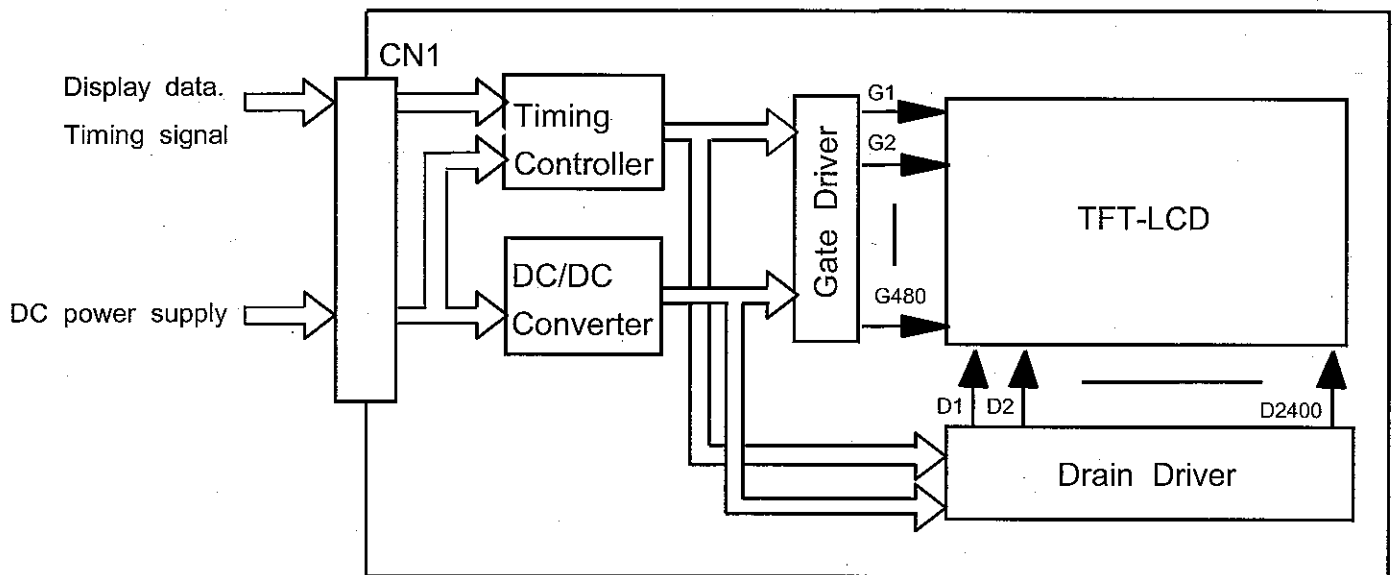
The inverter should be built-in a safety circuit which detects over current , over voltage and distorted wave form of lamp current.

6) Starting voltage should be more than V_s (Min.).

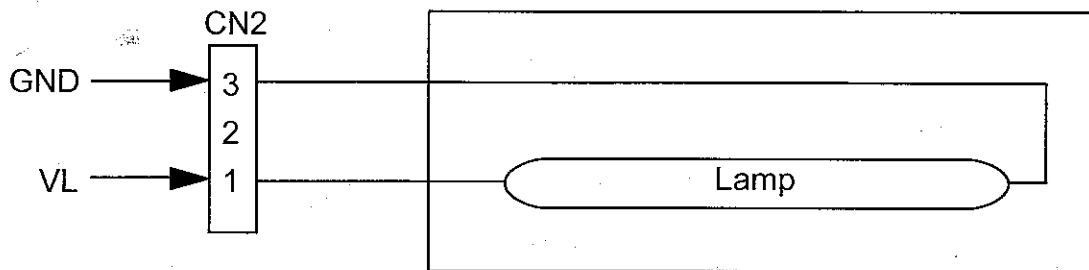
7) Ta=0°C

7. BLOCK DIAGRAM

7.1 IPS-TFT MODULE



7.2 BACK LIGHT UNIT



3 (GND) : White
 1 (VL) : Pink

8. INTERFACE PIN CONNECTION

8.1 TFT-LCD MODULE

CN1 《JAE ; FA5B040HP 1R3000》

PIN NO.	SYMBOL	DESCRIPTION	NOTE	
1	VDD	Power Supply (typ.(+3.3V))	1)	
2	VDD			
3	VDD			
4	VDD			
5	(IC)		3)	
6	DTMG	Display Timing Data		
7	VSS	GND (0V)	2)	
8	(NC)		4)	
9	VSS	GND (0V)	2)	
10	(NC)		4)	
11	VSS	GND (0V)	2)	
12	B5			B Data
13	B4			
14	B3			
15	VSS	GND (0V)	2)	
16	B2			B Data
17	B1			
18	B0			
19	VSS	GND (0V)	2)	
20	G5			G Data
21	G4			
22	G3			
23	VSS	GND (0V)	2)	
24	G2			G Data
25	G1			
26	G0			
27	VSS	GND (0V)	2)	
28	R5			R Data
29	R4			
30	R3			
31	VSS	GND (0V)	2)	
32	R2			R Data
33	R1			
34	R0			
35	(IC)		3)	
36	VSS	GND (0V)	2)	
37	VSS	GND (0V)	2)	
38	DCLK	Dot Clock		
39	VSS	GND (0V)	2)	
40	VSS			

Note 1) All VDD pins shall be connected to (+3.3V)(Typ.).

2) All VSS pins shall be grounded. Metal bezel is internally connected to VSS.

3) Please keep open electrically.

4) Unconnected to the module

8.2 BACK-LIGHT UNIT

CN2 : BHR-03VS-1 (JST)

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VL	Power Supply	
2	NC		
3	GND	GND (0V)	

8.3 RELATIONSHIP BETWEEN DISPLAY COLORS AND INPUT SIGNALS

color \ Input		Red Data						Green Data						Blue Data					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		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
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Red	Black	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	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	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
	Blue(1)	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	1	0
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note 1) Definition of gray scale :

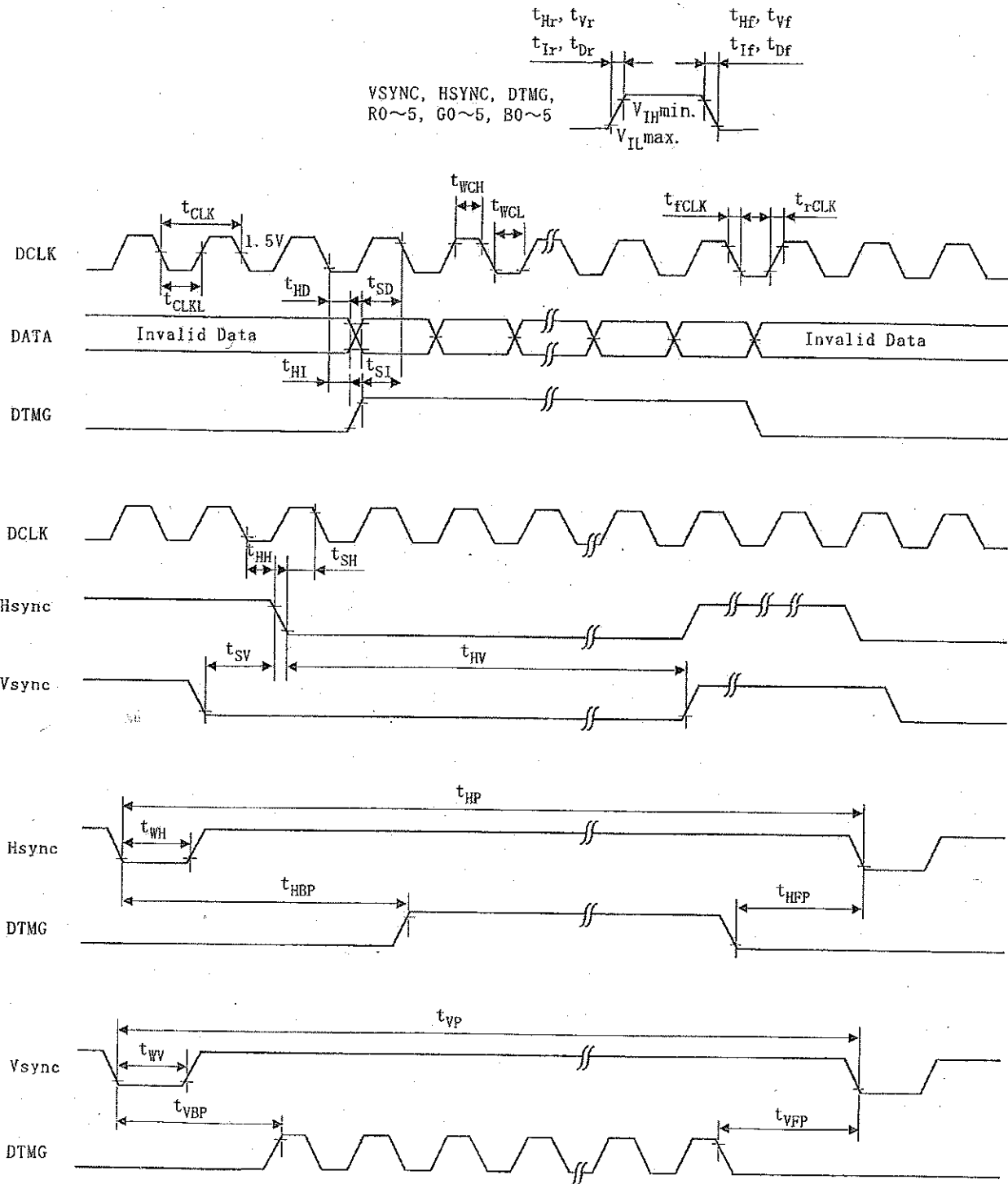
Color(n)---Number in parenthesis indicates gray scale level.

Larger n corresponds to brighter level.

2) Data : 1 : High, 0 : Low

9. INTERFACE TIMING

9.1 TIMING CHART

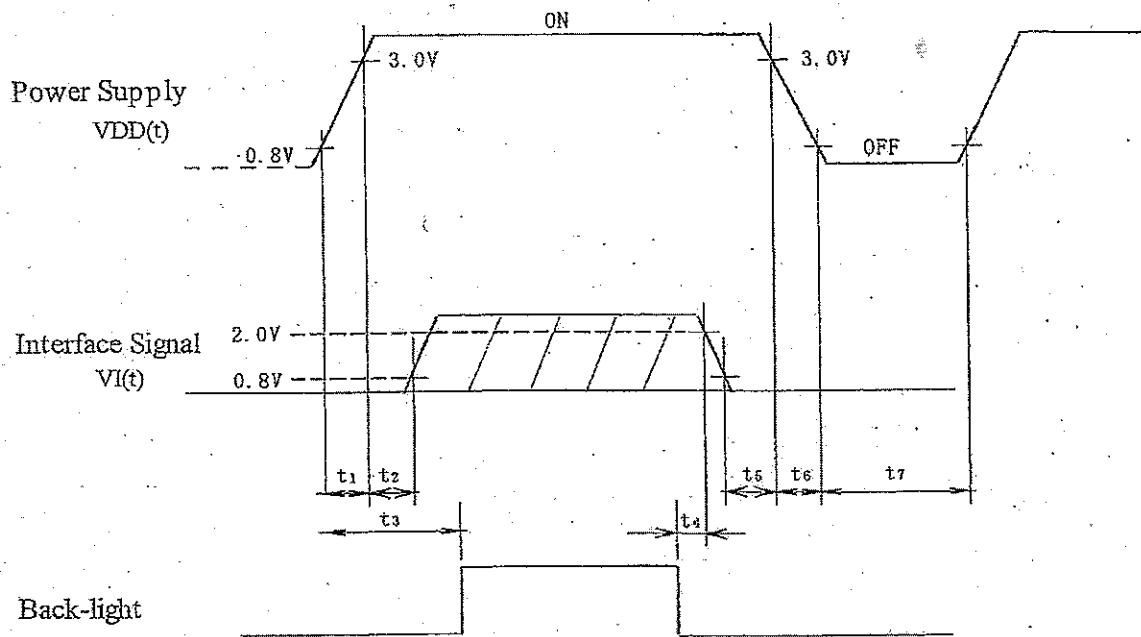


Note 1) The DTMG signal for the module is defined as above-mentioned timings for Vsync and Hsync signals.
 This Module synchronizes with only DTMG , and don't require inputting Vsync and Hsync.
 DTMG shall be Low level , while data is invalid (blanking period).
 The total number of Vsync shall be odd numbers.

9.2 INTERFACE TIMING SPECIFICATIONS

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE	
DCLK	Period	tCLK	25	30	33	ns		
	Width-Low	twCL	12	-	-			
	Width-High	twCH	12	-	-			
	Rise time	trCLK	-	-	4			
	Fall time	tfCLK	-	-	4			
	Duty	D	0.45	0.5	0.55	-		D= tCLKL/ tCLK
Hsync	Set up time	tSH	5	-	-	ns	for DCLK	
	Hold time	tHH	10	-	-			
	Period	tHP	944	1056	1088	tCLK		
	Width-Active	tWH	4	128	-			
	Rise/Fall time	tr,tfr	-	-	10	ns		
Vsync	Set up time	tSV	0	-	-	tCLK	for Hsync	
	Hold time	tHV	2	-	-			
	Period	tVP	515	525	610	tHP		
	Width-Active	tWV	1	2	-			
	Rise/Fall time	tr,tfr	-	-	10			ns
DTMG	Set up time	tSI	5	-	-	ns	for DCLK	
	Hold time	tHI	10	-	-			
	Rise/Fall time	tr,tfr	-	-	10	tCLK		
	Horizontal Back Porch	tHBP	7	88	-			
	Horizontal Front Porch	tHFP	-	40	-			
	Vertical Back Porch	tVBP	4	32	-	tHP		
	Vertical Front Porch	tVFP	-	11	-			
Data	Set up time	TSD	5	-	-	ns		for DCLK
	Hold time	THD	10	-	-			
	Rise/Fall time	tDr,tDf	-	-	4	ns		

9.3 TIMING BETWEEN INTERFACE SIGNALS AND POWER SUPPLY



POWER ON

$t_1 \leq 15\text{ms}$
 $0\text{ms} < t_2 \leq 45\text{ms}$
 $0.1\text{s} \leq t_3$

POWER OFF

$5\text{ms} \leq t_4$
 $0\text{ms} \leq t_5 \leq 45\text{ms}$
 $0\text{ms} \leq t_6 \leq 20\text{ms}$
 $0.4\text{s} \leq t_7$

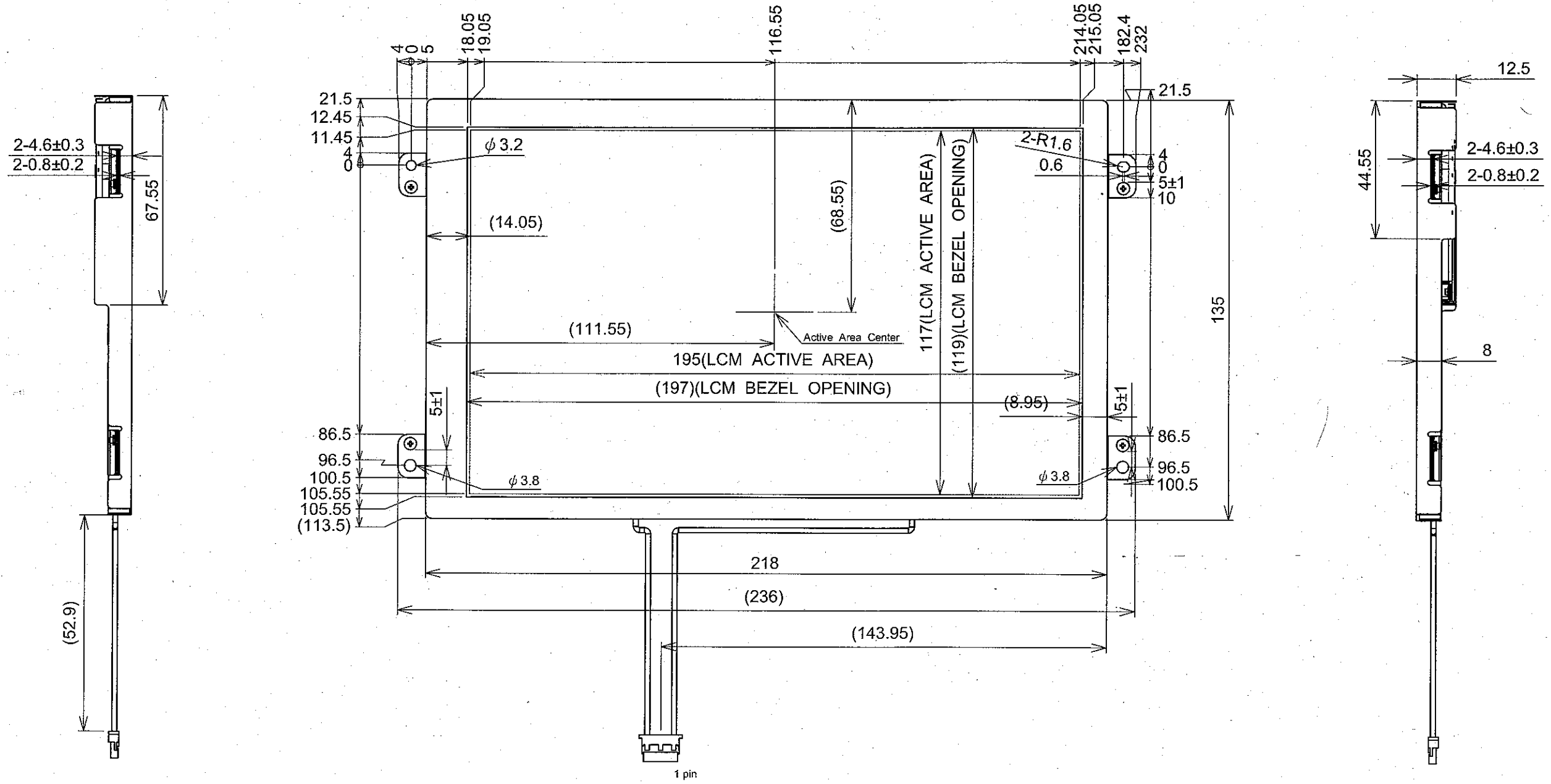
Note 1) Set $0\text{V} \leq VI(t) \leq VDD(t)$.

VI(t), VDD(t) mean the transient state of VI, VDD when the power supply is turned ON or OFF.

2) Do not keep interface signal high-impedance, while power is on.

10. DIMENSIONAL OUTLINE

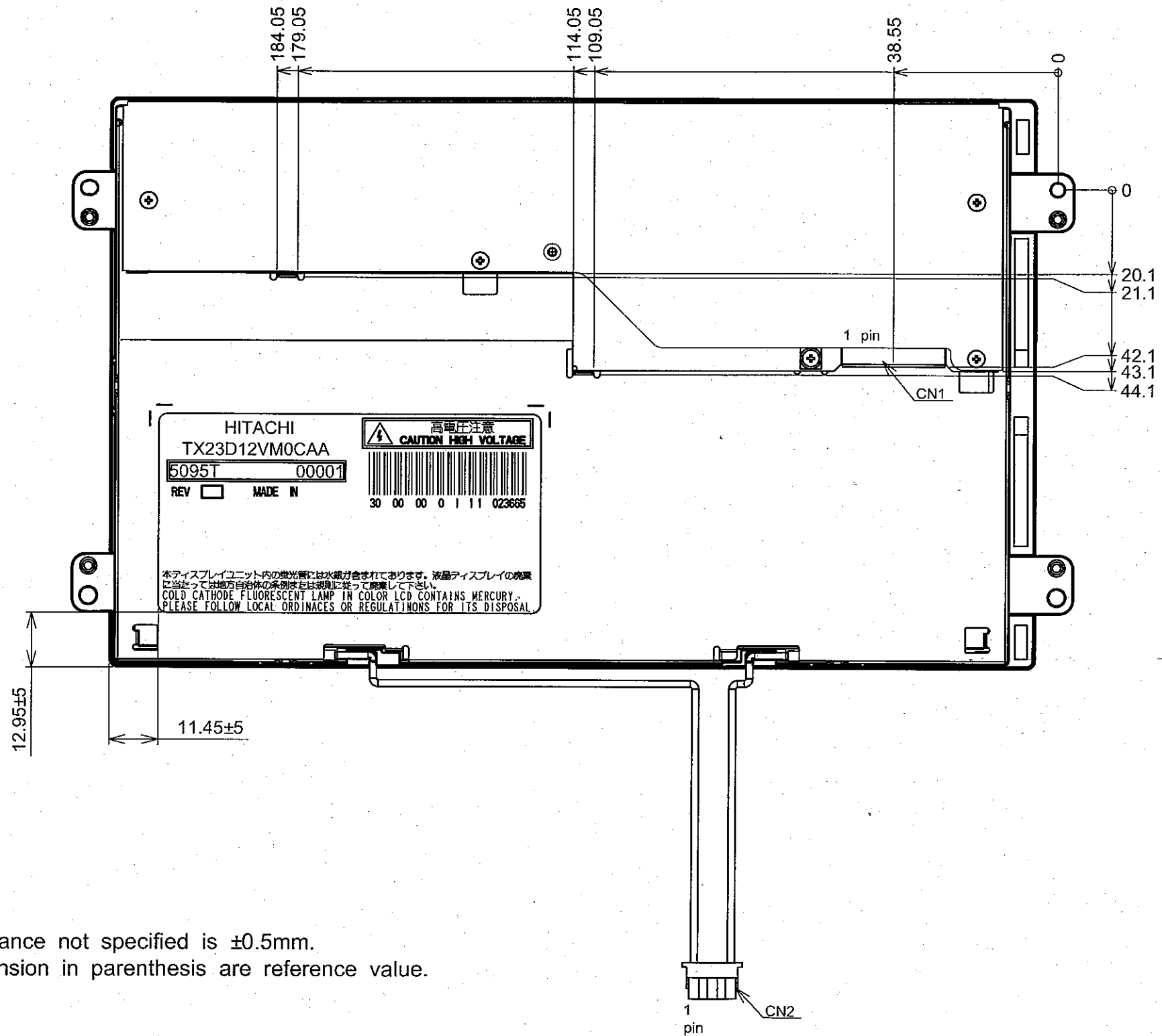
10.1 FRONT VIEW



Scale : NTS
Unit : mm

Scale : NTS
Unit : mm

10.2 BACK VIEW



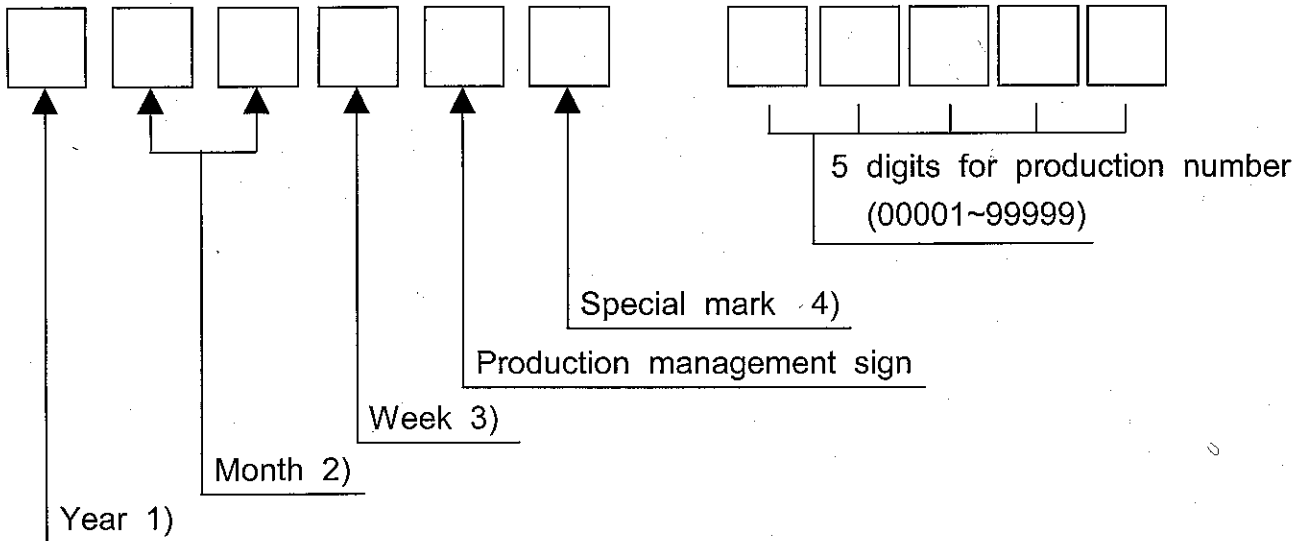
Scale : NTS
Unit : mm

- Note 1) Tolerance not specified is ± 0.5 mm.
2) Dimension in parenthesis are reference value.

Scale : NTS
Unit : mm

11. DESIGNATION OF LOT MARK

11.1 LOT MARK



Note 1)

Year	Mark
2007	7
2008	8
2009	9
2010	0
2011	1

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.

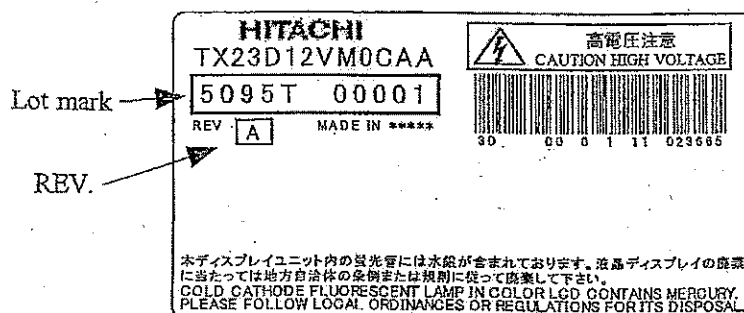
11.2 REVISION(REV.) CONTROL

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

11.3 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.



12. COSMETIC SPECIFICATIONS

12.1 CONDITION FOR COSMETIC INSPECTION

(1) Viewing zone

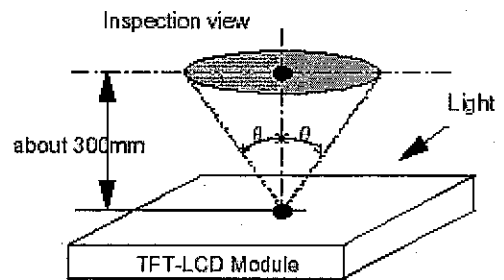
a) The figure shows the correspondence between eyes (of inspector) and TFT-LCD module.

$\theta \leq 45^\circ$: when non-operating inspection

$\theta \leq 5^\circ$: when operating inspection

b) Inspection should be executed only from front side and only A-zone.

Cosmetic of B-zone and C-zone are ignored.
(refer to 12.2 Definition of zone)



(2) Environmental

a) Temperature : 25°C

b) Ambient light : about 2000 [lx] and non-directive.

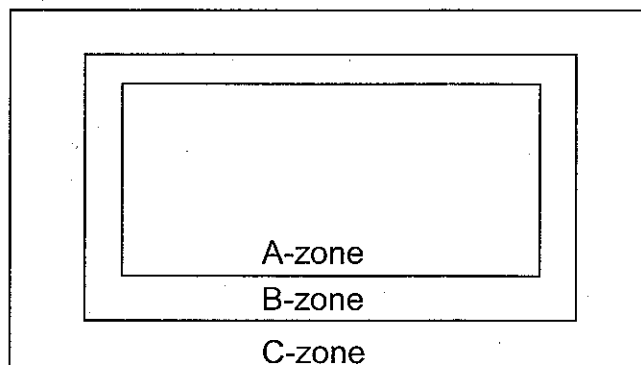
c) Back-light : when non-operating inspection , Back-light should be off.

12.2 DEFINITION OF ZONE

A-zone : Display area (pixel area)

B-zone : Area between A-zone and C-zone

C-zone : Metallic bezel area (include I/F connector)



12.3 COSMETIC SPECIFICATIONS

When displaying conditions are not stable (ex. at turn on or off), the following specifications are not applied.

Operating inspection

No	ITEM			MAX. ACCEPTABLE NUMBER	UNIT	NOTE
				A-ZONE		
1	Dot defect	Sparkle mode	1-dot	2	pcs	1),2),4)
			2-dots	1	Units	1),2),5)
			3-dots	0		
			Total	2	Units	1),2)
		Black mode	1-dot	3	pcs	1),3),4)
			2-dots	2	Units	1),3),5)
			3-dots	0		
		Total	3	Units	1),3)	
		Total	Density	1	Units/φ80mm	1),2),3),6)
			Total	3	Units	1)
2	Line defect			Serious one is not allowed	-	-
3	Uneven brightness					
4	Stain inclusion Line shape W : width (mm) L : length (mm)	W ≤ 0.02	L : Ignore	Ignore	pcs	7)
		W ≤ 0.03	L ≤ 2.0	10		
			L > 2.0	0		
		W ≤ 0.06	L ≤ 1.0	10		
			L > 1.0	0		
W > 0.06	-	(See dot shape)				
5	Stain inclusion Dot shape D : ave. dia (mm)	D ≤ 0.22		Ignore	pcs	7)
		D ≤ 0.33		5		
		D > 0.33		0		
6	Scratch on polarizer Line shape W : width (mm) L : length (mm)	W ≤ 0.01	L : Ignore	Ignore	pcs	8)
		W ≤ 0.02	L ≤ 40	10		
			L > 40	0		
		W ≤ 0.04	L ≤ 20	10		
L > 20	0					
7	Scratch on polarizer Dot shape D : ave. dia (mm)	D ≤ 0.2		Ignore	pcs	8)
		D ≤ 0.4		10		
		D > 0.4		0		

Non-operating inspection

No	ITEM		Max. acceptable number	Unit	Note
			A-zone		
8	Bubbles, peeling In polarizer [D:ave.dia(mm)]	D ≤ 0.3	Ignore	pcs	8)
		D ≤ 0.5	10		
		D ≤ 1.0	5		
		D > 1.0	0		
9	Wrinkles on polarizer		Serious one is not allowed	-	-

Note 1) Dot defect : defect area > 1/2 dot

2) Sparkle mode : brightness of dot is more than 30% at black. (visible to eye)

3) Black mode : brightness of dot is less than 70% at white. (visible to eye)

4) 1 dot : defect dot is isolated, not attached to other defect dot.

5) N dots : N defect dots are consecutive. (N means the number of defects dots)

6) Density : number of defect dots inside 80mm φ.

7) Those stains which can be wiped out easily are acceptable.

8) Polarizer area inside of B-zone is not applied.

13. PRECAUTION

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

13.1 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 push the exposed polarizer.
- (3) The module should be installed with mounting holes at each corner 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.

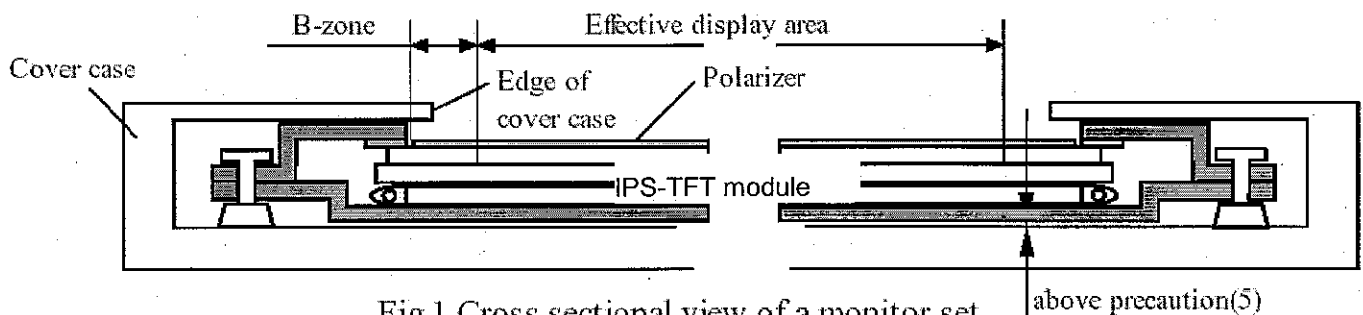


Fig.1 Cross sectional view of a monitor set

- (6) Materials included acetic acid and choline should not be used for a cover case as well as other parts and boards near a module. Acetic acid attacks a polarizer. Choline attacks electric circuits due to electro-chemical reaction.
- (7) 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.
- (8) The surface of a polarizer should be gently wiped with absorbent cotton , chamois or other soft materials slightly contained isopropyl alcohol when the surface becomes dirty. Isopropyl alcohol as cleaning chemicals is recommended in order to clean adhesives which fix front / rear polarizers on a IPS-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.
- (9) Saliva or water drops should be immediately wiped off. Otherwise , the portion of a polarizer may be deformed and its color may be faded.
- (10) The module should not be opened or modified. It may cause not to operate properly.
- (11) 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 use clean soft gloves and clean finger stalls when a module is handled at incoming inspection process and production (assembly) process.
- (12) Lamp(CCFL) cables should not be pulled and held.

(13) Don't push the hatched area as shown in Fig.2.

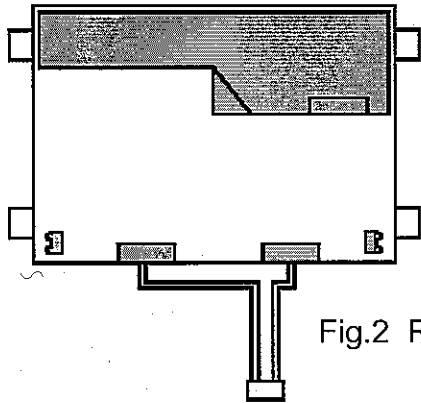


Fig.2 Rear view of a TFT-LCD Module

13.2 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 mis-operation of a module. The level of spike noise should be as follows : $-500\text{mV} \leq \text{over- and under- shoot of VDD} \leq +500\text{mV}$, $50\text{nsec} \leq \text{width}$.
- (3) Optical response time, luminance and chromaticity depend on the temperature of a IPS-TFT module. (At lower temperature, it becomes longer.)
- (4) Response time of CCFL luminance become longer at lower at lower temperature operation.
- (5) Sudden temperature change may cause dew on and / or in a module. Dew makes damage to a polarizer and / or electrical contacting portion. Dew causes fading of display quality.
- (6) Fixed patterns displayed on a module for a long time may cause after-image. It will be recovered soon.
- (7) 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.
- (8) Inserting or pulling I/F connectors causes any trouble when power supply and signal dates are on-state. I/F connectors should be inserted and pulled after power supply and signal dates are turned off.

13.3 ELECTROSTATIC DISCHARGE CONTROL

- (1) Since a module consists of a IPS-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.

13.4 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.

13.5 PRECAUTION TO STORAGE

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°C 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.

13.6 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 peeled 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 remained adhesive or its vestige on the polarizer should be wiped off with absorbent cotton or other soft materials slightly contained isopropyl alcohol.

13.7 SAFETY

- (1) Since a IPS-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 CCFL inverter should be designed to include the function of output shut down in case the output overcurrent happen due to any back-light trouble. The shut down function should be assured to work in abnormal condition at the actual systems.
- (3) The module should not be taken apart and should not put conductive thing into the Module, so that back-light drives by high voltage.

13.8 ENVIROMENTAL PROTECTION

- (1) This IPS-TFT module contains cold cathode fluorescent lamps. Please follow local ordinance or regulations for it's disposal.

13.9 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, 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.

13.10 OTHERS

(1) Electrical components which may not affect electrical performance are subjective to change without notice because of their availability.