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# HITACHI

Electron Tube & Devices  
Division, Hitachi, Ltd.

Date : Nov. 21. '95

For Messrs \_\_\_\_\_

## CUSTOMER'S ACCEPTANCE SPECIFICATIONS

### TECHNICAL DATA

#### TX31D24VC1CAA

#### CONTENTS

No.	Item	Sheet No.	Page
-	COVER	3284TTD 0431-1	1-1/1
-	RECORD OF REVISION	3284TTD 0431-1	2-1/1
-	APPLICATION	3284TTD 0431-1	3-1/1
1	ABSOLUTE MAXIMUM RATINGS	3284TTD 0431-1	4-1/1
2	OPTICAL CHARACTERISTICS	3284TTD 0431-1	5-1/2~2/2
3	ELECTRICAL CHARACTERISTICS	3284TTD 0431-1	6-1/1
4	BLOCK DIAGRAM	3284TTD 0431-1	7-1/1
5	INTERFACE PIN CONNECTION	3284TTD 0431-1	8-1/2~2/2
6	INTERFACE TIMING	3284TTD 0431-1	9-1/3~3/3
7	DIMENSIONAL OUTLINE	3284TTD 0431-1	10-1/1
8	DESIGNATION OF LOT MARK	3284TTD 0431-1	11-1/1
9	-	-	-
10	PRECAUTION	3284TTD 0431-1	13-1/4~4/4

Electron Tube & Devices Division, Hitachi, Ltd.	Sh. No.	3284TTD 0431-1	Page	1-1/1
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RECORD OF REVISION

Date	Sheet No.	Summary

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	2-1/1
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## APPLICATIONS

This specification is applied to the following TFT Liquid Crystal Display Module with Back-light unit.

Note : Inverter device for Back-light is not built in so it should be prepared by yourself.

- Type Name : TX31D24VC1CAA
- Display Area : H246×V184.5 [mm]
- Display Dots : H(800×3)×V600 [dots]  
(Display Pixels) (H800×V600 pixels)
- Color Pixel Arrangement : R·G·B Vertical Stripe
- Display Mode : Transmissive Mode  
Normally White Mode
- Color Number : 262k Colors
- Viewing Angle : 6:00 Direction
- Dimensions Outline : H276.5×V199.0×t8.0 [mm]
- Weight : Less than 500 [g]

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	3-1/1
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# 1. ABSOLUTE MAXIMUM RATINGS

## 1.1 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

I T E M	OPERATING		STORAGE		UNIT	Note
	MIN.	MAX.	MIN.	MAX.		
Ambient Temperature	10	40	-20	60	°C	1)
Humidity	2)		2)		%RH	1)
Vibration	-	4.9 (0.5G)	-	19.6 (2G)	m/s <sup>2</sup>	3)
Shock	-	29.4 (3G)	-	490 (50G)		4)
Corrosive Gas	NOT ACCEPTABLE		NOT ACCEPTABLE		-	
Illuminance of LCD surface	-	50,000	-	50,000	lx	

Note 1) Environmental temperature and humidity of this unit, not of system installed with this unit.

At low temperature the brightness of CFL drop and the life time of CFL become to be short.

- 2) Ambient temp.  $T_a \leq 40^\circ\text{C}$  : 85%RH MAX. Without condensation  
 $T_a > 40^\circ\text{C}$  : Absolute humidity must be lower than the humidity of 85%RH at  $40^\circ\text{C}$ . Without condensation

3) 20~50Hz.

4) 7ms.

## 1.2 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

### (1) TFT LIQUID CRYSTAL DISPLAY MODULE

$V_{s,s} = 0\text{V}$

I T E M	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	$V_{DD}$	0	4.3	V	
Input Voltage	$V_i$	-0.2	$V_{DD} + 0.2$	V	1)
Electro-static Durability	$V_{ESD0}$	$\pm 100$		V	2), 3)
	$V_{ESD1}$	$\pm 8$		kV	2), 4)

Note 1) Vsync, Hsync, DTMG, DCLK, RD, GD, BD, are subjected.

2) 200pF~250Ω 25°C~70%RH

3) I/F connector pins are subjected.

4) The surface of Metal bezel and LCD panel are subjected.

### (2) BACK-LIGHT UNIT

I T E M	SYMBOL	MIN.	MAX.	UNIT
Lamp Current	$I_L$	0	5	mA
Lamp Voltage	$V_L$	0	2000	V

Hitachi, Ltd.	Date	Nov. 21. '95	Sh. No.	3284TTD 0431-1	Page	4-1/1
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## 2. OPTICAL CHARACTERISTICS

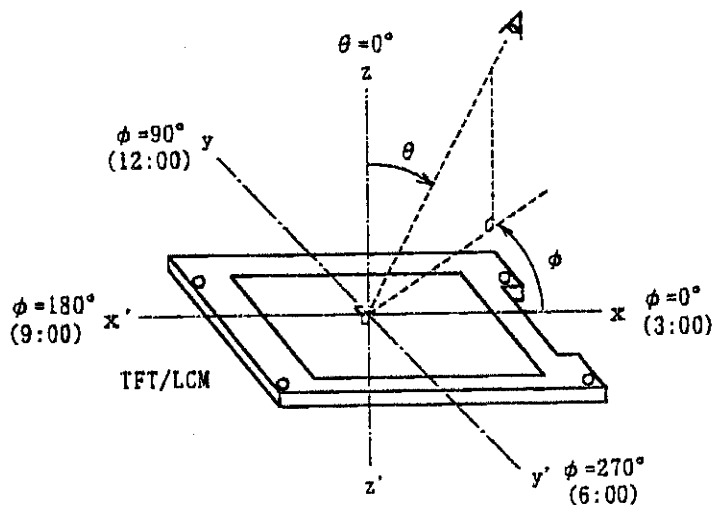
The following items are measured when the conditions of this unit (TFT panel and Back-light) and measuring systems are stable. The ambient light excluding Back-light is nothing.

• Measuring equipment : TOPCON BM-7, Prichard 1980, or equivalent

Temperature of LCD=25°C,  $V_{DD}=3.3V$ ,  $f_v=60Hz$ ,  $I_L=3.5mA$

I T E M		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio		CR	$\theta=0^\circ$ Note 1)	30	80	-	-	2)
Response Time	RISE	$t_r$		-	35	90	ms	3)
	FALL	$t_f$		-	20	60		
Brightness (white)		$T_{wh}$		-	70	-	cd/m <sup>2</sup>	
Color of CIE	Red	$x$		-	(0.58)	-	-	
		$y$		-	(0.34)	-		
	Green	$x$		-	(0.30)	-		
		$y$		-	(0.54)	-		
	Blue	$x$		-	(0.15)	-		
		$y$		-	(0.13)	-		
	White	$x$	-	(0.31)	-			
		$y$	-	(0.32)	-			

Note 1) Definition of Viewing Angle

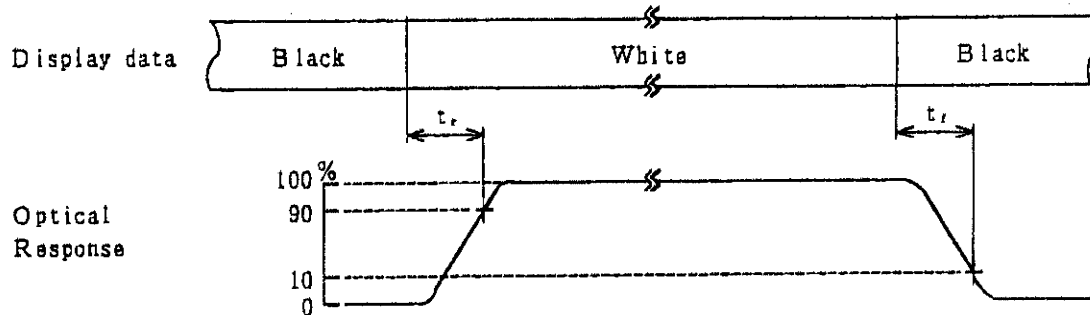


Hitachi, Ltd.	Date Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page 5-1/2
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Note 2) Definition of Contrast Ratio (CR)

$$CR = \frac{\text{Brightness when displaying White raster}}{\text{Brightness when displaying Black raster}}$$

Note 3) Definition of Response Time



Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	5-2/2
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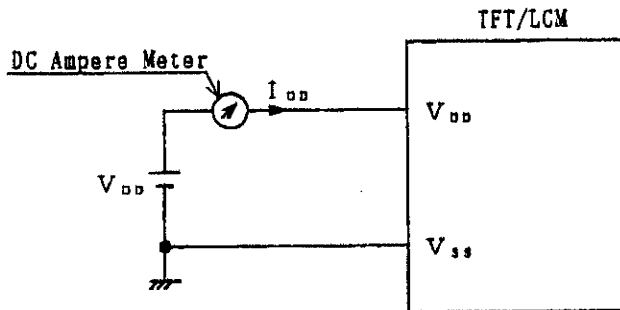
### 3. ELECTRICAL CHARACTERISTICS

#### (1) TFT LIQUID CRYSTAL DISPLAY MODULE

Ta=25°C, V<sub>ss</sub>=0V

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage	V <sub>DD</sub>	3.0	3.3	3.6	V	
Input Voltage for Logic Circuits	Hi	V <sub>I.H</sub>	0.75×V <sub>DD</sub>	—	V <sub>DD</sub>	1)
	Lo	V <sub>I.L</sub>	V <sub>ss</sub>	—	0.25×V <sub>DD</sub>	
Power Supply Current	I <sub>DD</sub>	—	190	370	mA	2), 3)
Vsync Frequency	f <sub>v</sub>	—	60	65	Hz	
Hsync Frequency	f <sub>H</sub>	—	37.5	39.2	kHz	
DCLK Frequency	f <sub>CLK</sub>	—	38.4	40	MHz	

- Note 1) Display data pins and Timing signal pins are subjected.  
 2) f<sub>v</sub>=60Hz, f<sub>CLK</sub>=36MHz, V<sub>DD</sub>=3.3V, DC Current



- Typical value is measured when displaying Black raster.  
 Maximum is measured when displaying Pixel-checkers.  
 3) Current capacity for V<sub>DD</sub> power source should be larger than 3A.

#### (2) BACK-LIGHT UNIT

Ta=25°C

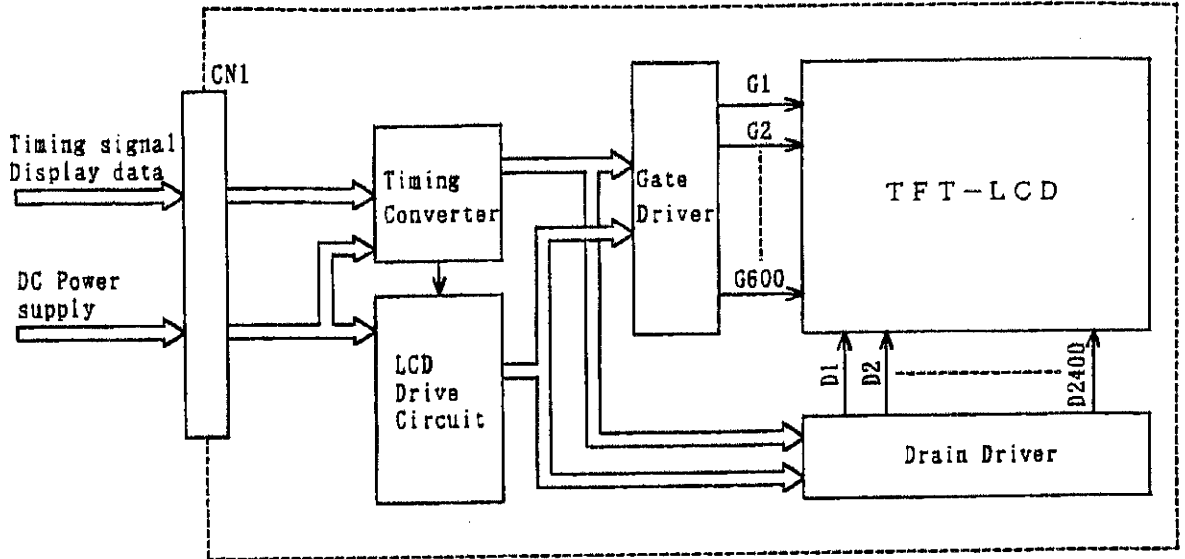
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Lamp Current	I <sub>L</sub>	2.0	3.5	5.0	mArms	1)
		—	—	7.0	mA0-peak	
Lamp Voltage	V <sub>L</sub>	—	595	660	Vrms	
Frequency	f <sub>L</sub>	—	50	—	kHz	2)
Starting Lamp Voltage	V <sub>s</sub>	—	—	930	Vrms	3)
		—	—	1620		

- Note 1) Higher I<sub>L</sub> cause the short life time of CFL.  
 2) Lamp frequency may produce interference with Hsync frequency, causing beat or flicker on the display. Therefore lamp frequency shall be as different as possible from Hsync frequency, to avoid interference.  
 3) Ta=0°C  
 4) Regarding output voltage of transformer on inverter circuit, when output is open, more than 1700V is recommended.

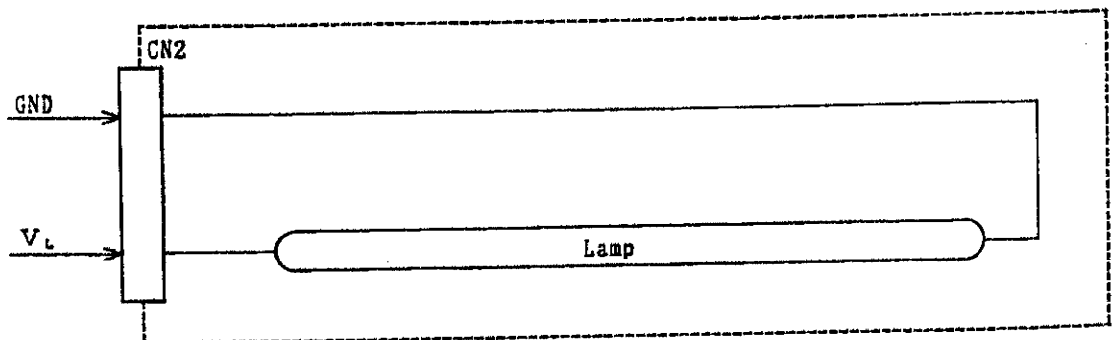
Hitachi, Ltd.	Date Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page 6-1/1
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#### 4. BLOCK DIAGRAM

##### (1) TFT LIQUID CRYSTAL DISPLAY MODULE



##### (2) BACK-LIGHT UNIT



Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	7-1/1
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## 5. INTERFACE PIN ASSIGNMENT

(1) TFT LIQUID CRYSTAL DISPLAY MODULE  
CN1 (HIROSE:DF9B-41P-1V)

Pin No	SYMBOL	DESCRIPTION	NOTE
1	Vss	GND (0V)	1)
2	DCLK	Dot Clock	
3	Vss	GND (0V)	1)
4	Hsync	Horizontal Synchronization	
5	Vsync	Vertical Synchronization	
6	Vss	GND (0V)	1)
7	Vss		
8	Vss		
9	R0	Red Data	
10	R1		
11	R2		
12	Vss	GND (0V)	1)
13	R3	Red Data	
14	R4		
15	R5		
16	Vss	GND (0V)	1)
17	Vss		
18	Vss		
19	G0	Green Data	
20	G1		
21	G2		
22	Vss	GND (0V)	1)
23	G3	Green Data	
24	G4		
25	G5		
26	Vss	GND (0V)	1)
27	Vss		
28	Vss		
29	B0	Blue Data	
30	B1		
31	B2		
32	Vss	GND (0V)	1)
33	B3	Blue Data	
34	B4		
35	B5		
36	Vss	GND (0V)	1)
37	DTMG	Display Timing	
38	VSS	GND (0V)	
39	Vss	Power Supply (+3.3V)	2)
40	Vss		
41	(IC)		3)

- Note 1) All Vss pins should be connected to GND (0V).  
Metal bezel is connected internally to Vss.  
2) All Vss pins should be connected to +3.3V.  
3) Keep open. Hitachi test use only.

(2) BACK-LIGHT UNIT  
CN2 (JST:BHR-03VS-1)

Pin No.	SYMBOL	DESCRIPTION
1	V <sub>L</sub>	Power Supply
2	(NC)	
3	GND	GND (0V)

Hitachi, Ltd.	Date Nov. 21. '95	Sh. No.	3284TTD 0431-1	Page	8-1/
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RELATIONSHIP BETWEEN DISPLAYED COLOR AND INPUT DATA.

INPUT DATA		R DATA					G DATA					B DATA							
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
COLOR		MSE					LSEMSE					LSEMSE					LSE		
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (0)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE (0)	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
	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 (62)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED (61)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	RED (2)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED (1)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
RED (0)	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 (62)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN (61)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	GREEN (2)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	GREEN (1)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
GREEN (0)	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 (62)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE (61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
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	BLUE (2)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	BLUE (1)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
BLUE (0)	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) --- n indicates gray scale level. Lower n means brighter level.

2) Data : 1:Hi, 0:Lo

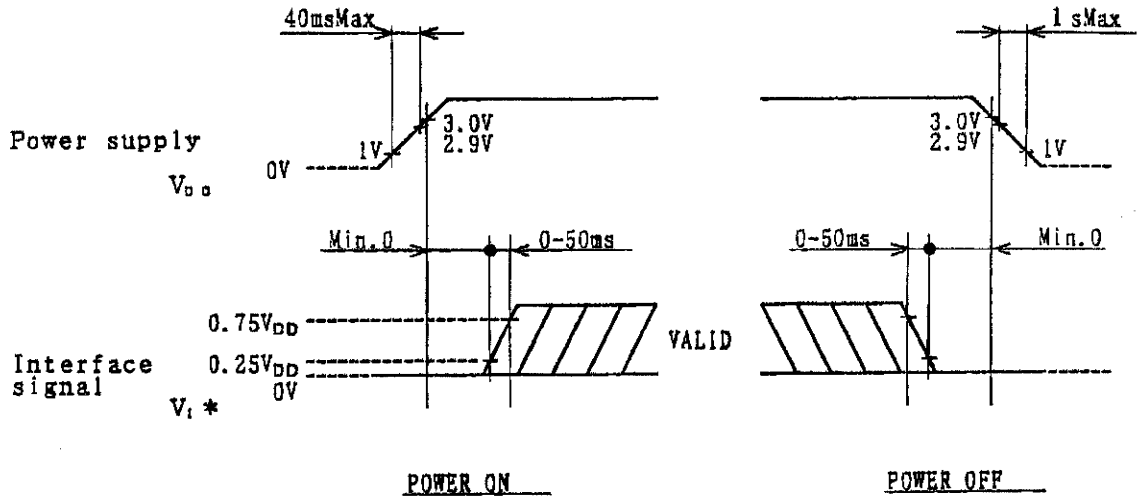
Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	8-2/2
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## 6. 2 INTERFACE TIMING SPECIFICATION

I T E M	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE	
DCLK	Period	$t_{CLK}$	25	(26)	—	ns	
	Width-Low	$t_{wCL}$	8	—	—		
	Width-High	$t_{wCH}$	8	—	—		
	Rise Time	$t_{r,CLK}$	—	—	25		
	Fall Time	$t_{f,CLK}$	—	—	25		
	Duty	D	0.45	0.5	0.55	—	$D=t_{wCH}/t_{CLK}$
Hsync	Set up Time	$t_{SH}$	6	—	—	ns	for DCLK
	Hold Time	$t_{HH}$	6	—	—		
	Period	$t_{HP}$	$1052-t_{HSP}$	(1024)	1200	$t_{CLK}$	
	Width-Active	$t_{WH}$	8	—	120		
	Rise/Fall Time	$t_{r,f}$	—	—	30	ns	
Vsync	Set up Time	$t_{SV}$	0	—	—	$t_{CLK}$	for Hsync
	Hold Time	$t_{HV}$	2	—	—		
	Period	$t_{VP}$	603	(625)	1000	$t_{HP}$	
	Width-Active	$t_{WV}$	1	—	24		
	Rise/Fall Time	$t_{r,f}$	—	—	50	ns	
DTMG	Set up Time	$t_{SI}$	6	—	—	ns	for DCLK
	Hold Time	$t_{HI}$	6	—	—		
	Rise/Fall Time	$t_{r,f}$	—	—	30	ns	
	Horizontal Back Porch	$t_{HBP}$	32	—	—	$t_{CLK}$	
	Horizontal Front Porch	$t_{HFP}$	16	—	—		
	Vertical Back Porch	$t_{VBP}$	0	—	—	$t_{HP}$	
	Vertical Front Porch	$t_{VFP}$	3	—	—		
DATA	Set up Time	$t_{SD}$	6	—	—	ns	for DCLK
	Hold Time	$t_{HD}$	6	—	—		
	Rise/Fall Time	$t_{r,f}$	—	—	25	ns	

### 6.3 TIMING BETWEEN INTERFACE SIGNAL AND POWER SUPPLY



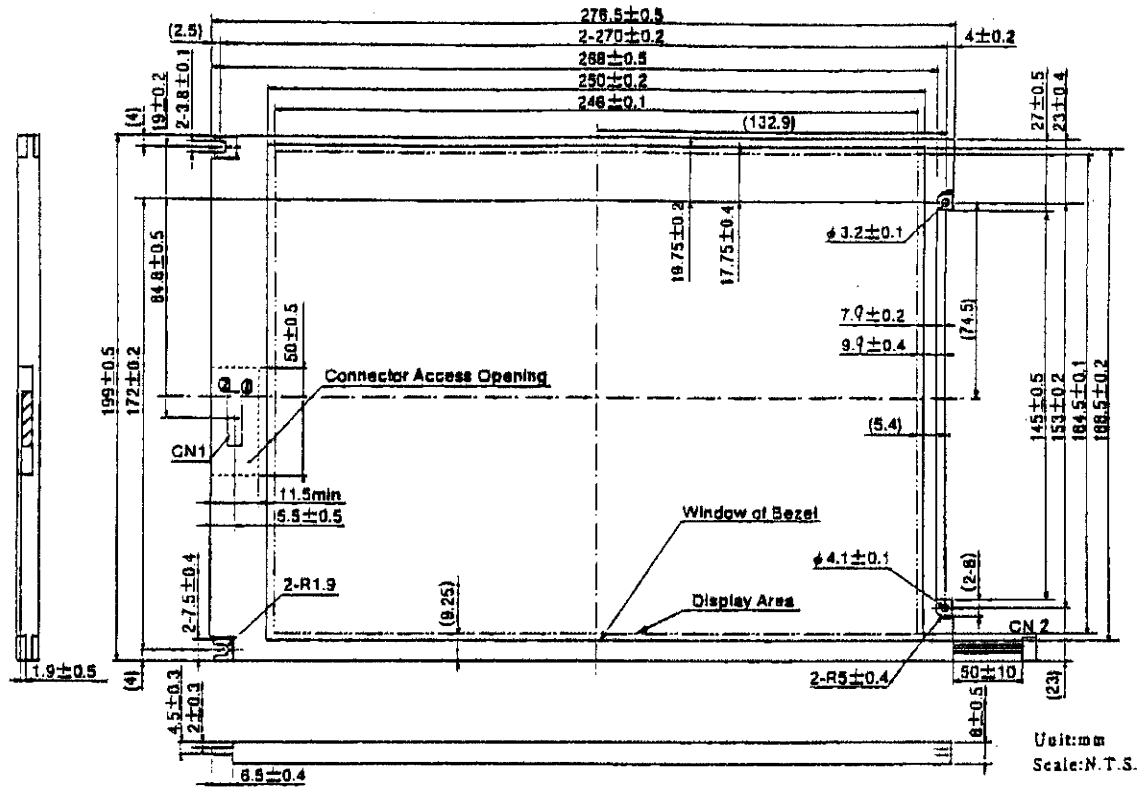
\* Set  $0V \leq V_i(t) \leq V_{DD}(t)$ .

Here,  $V_i(t)$ ,  $V_{DD}(t)$  indicate the transitive state of  $V_i$ ,  $V_{DD}$  when power supply is turned ON or OFF.

NOTE 1) Do not keep interface signal high-impedance when power on.

Hitachi, Ltd.	Date	Nov. 21, '95	Sl. No.	3284TTD 0431-1	Page	9-3/3
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## 7. DIMENSIONAL OUTLINE



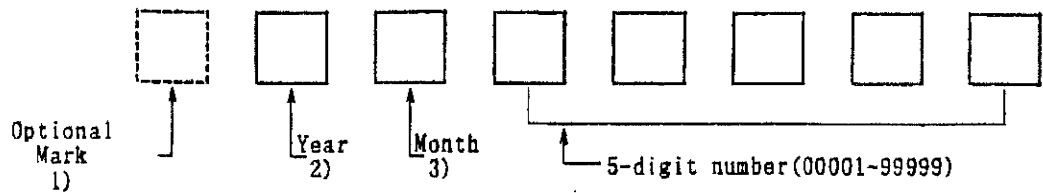
### Note

- 1) CN1 : Hirose DF9B-41P-1V  
( Mating side connector )  
DF9\*-41S-1V
- 2) CN2 : J. S. T. BHR-03VS-1  
Cable length is about  
50mm.  
( Mating side connector )  
SMO2 (8. 0) B-BHS-TB
- 3) Tolerance not specified is  $\pm 0.5$ mm.
- 4) Dimensions in parenthesis are  
reference value.
- 5) Position, size and form of tab  
and grooves on Metal bezel are  
not specified.

Hitachi, Ltd.	Date Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page 10-1/1
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## 8. DESIGNATION OF LOT MARK

### 8.1 LOT MARK



NOTE 1) Optional Mark for HITACHI.

#### 2) Year

Year	' 95	' 96	' 97	' 98	' 99	2000	' 01	' 02	' 03	' 04	' 05
Mark	5	6	7	8	9	0	1	2	3	4	5

#### 3) Month

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mark	A	B	C	D	E	F	G	H	J	K	L	M

### 8.2 LOCATION OF LOT MARK

Lot mark is printed on Label. And Label is attached to the surface of Metal bezel.

The form of character will be changed without notice.

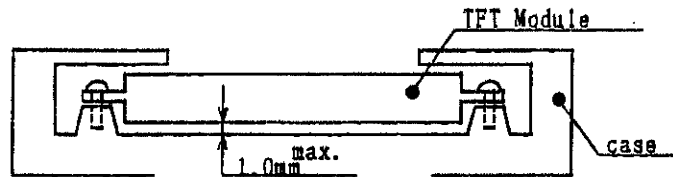
Hitachi, Ltd.	Date	Nov. 21, ' 95	Sh. No.	3284TTD 0431-1	Page	11-1/1
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## 10. PRECAUTIONS

Please pay attention to the followings when you use this TFT/LCD module with Back-light unit.

### 10.1 MOUNTING PRECAUTION

- (1) You must mount Module using mounting holes arranged in 4 corners.
- (2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to Module. And the case which Module is mounted should have sufficient strength so that external force is not transmitted directly to Module.
- (3) To improve the strength of module against the mechanical shock the space between module and the case should be less than 1.0mm.



- (4) Please attach the surface with a transparent protective plate in order to protect the polarizer and LC cell. Transparent protective plate should have sufficient strength in order to avoid external force.
- (5) You should adopt radiation structure to satisfy the temperature specification.
- (6) Acetic acid type and choline type materials for the cover case are not desirable because the former generate corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (7) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub by dustclothes with chemical treatment. Do not touch the surface of polarizer with bare hand or greasy close. (Some cosmetics are detrimental to the polarizer.)
- (8) When the surface become dusty, please wipe gently with absorbent cotton or other soft materials chamols soaked petroleum benzin. Normal-Hexane is recommended for cleaning the adhesives used to attach front /rear polarizers. Do not use acetone, toluen and alchol because they cause chemical damage to the polarizer.
- (9) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (10) Do not open the case because inside circuits have not sufficient strength.
- (11) Use fingerstalls of soft gloves in order to keep clean display quality, when you handle the device for incoming inspection and assembly.
- (12) Do not pull or do not fold the CFL cable.

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	13-1/4
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## 10. 2 OPERATING PRECAUTION

- (1) The spike noise causes the mis-operation of circuits. Be lower the spike noise as follows :

$V_{o.s} = \pm 200\text{mV}$ ,  $V_i = \pm 200\text{mV}$  (Over and under shoot voltage)

- (2) Response time depends on the temperature. (In lower temperature, it becomes longer).

And also Transmittance and Color depend on the temperature.

- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower).

And in lower temperature, response time (required time that brightness is stable after turn on) becomes longer.

- (4) Be carefull for condensation at sudden temperature change.

Condensation make damage to polarizer or electrical contact part. And after fading condensation, smear or spot will occur.

- (5) When fixed patterns are displayed at long times, afterimage is likely to occur.

- (6) Module has high frequency circuit. If you need to shield the electromagnetic noise, please do in yours.

- (7) When Back-light unit is operating, it sounds.

If you need to shield the noise, please do in yours.

- (8) Please connect the Back-light connector to the inverter circuit directly.

The long cable between CFL and the inverter may cause the brightness drop of CFL and may cause the rise of starting lamp Voltage ( $V_s$ ).

- (9) Do not connect or remove the module from main system with power applied.

## 10. 3 ELECTROSTATIC DISCHARGE CONTROL

Since Module is composed with electronic circuit, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through list band etc.. And don't touch I/F pin directly.

## 10. 4 PRECAUTION FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	13-2/4
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## 10. 5 STORAGE

When storing Module as spares for long time, the following precautions are necessary.

- (1) Store them in a dark place ; do not expose them to sunlight or fluorescent light.

Keep the temperature between 5°C and 35°C at normal humidity.

- (2) The polarizer surface should not come in contact with any other object.

It is recommended that they be stored in the container in which they were shipped.

## 10. 6 HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) When the protection film is peeled off, static electricity is generated between the film and the polarizer.

This film should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

- (2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain more on the polarizer. So please carefully peel off the protection film without rubbing it against the polarizer.

- (3) When the Module with protection film attached is stored for long time, sometimes there remains a very small amount of glue, still on the polarizer after the protection film is peeled off.

Please refrain from storing the Module at the high temperature and high humidity for glue is apt to remain in these condition.

- (4) The Glue may be taken for the Modules failure, but you can remove the Glue easily.

When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with Normal-hexane.

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	13-3/4
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## 10.7 SAFETY

- (1) If Module is broken, be careful to handle not to injure. (TFT/LCD and Lamp are made of glass.)

Please wash hands sufficiently when you touch the liquid crystal coming out from broken LCDs.

- (2) As it is possible for PCB or other electronic parts of module to smell to smoke and to take fire because of the short circuit. Please design the circuit of your instrument not to flow the electric current to TFT/LCD module more than 1A (by apply the fuse for example).
- (3) As Back-light unit has high voltage circuit internal, do not open the case and do not insert foreign materials in the case.

Hitachi, Ltd.	Date	Nov. 21, '95	Sh. No.	3284TTD 0431-1	Page	13-4/4
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