

EPSON

Product Information

Product Name: D-TFD LCD Block

Product Number: LB18DB-BD Series

Document Number: MPI98021-02E

Oct. 21, 1998

Note:

- 1) This document is a technical information of our new product. The final specifications and ratings depend on the product specification.
- 2) Please acknowledge beforehand that descriptions in this document might be revised without notice.
- 3) No part of this document may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson.
- 4) In the case of application for direct control of vehicle, or concerning the safety matter, please inform our sales section in advance.
- 5) Please do not use this product for applications requiring high level reliability, such as space flight, aircraft, and medical instruments.

SEIKO EPSON CORPORATION

ELECTRONIC DEVICES & COMPONENTS MARKETING DIVISION
ED Marketing & Engineering Department
LD Marketing & Engineering Group

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Outward Drawing is annexed at the last page.

1. Scope

This document applies to the 4.4 cm (1.75") D-TFD (Digital Thin Film Diode) liquid crystal display block LB18DB-BC series (standard: LB18DB-BC10) manufactured by the LO Operations Division of SEIKO EPSON CORPORATION. Please acknowledge beforehand that descriptions in this document might be revised without notice.

2. Overview

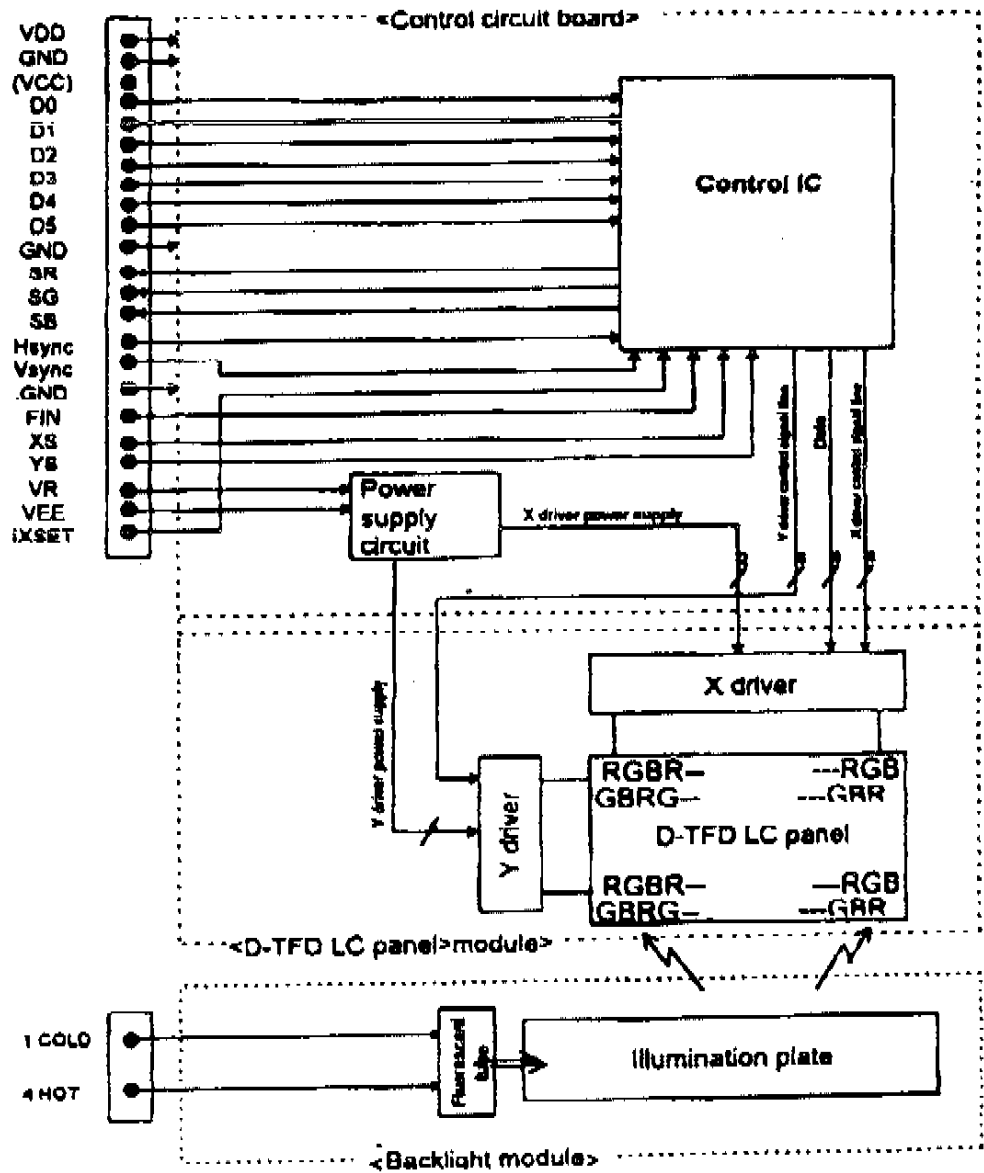
The 4.4 cm (1.75") D-TFD liquid crystal panel block is an integrated unit which consists of a liquid crystal panel module, a backlight module, and a control circuit board for driving the panel. It can be used as a display monitor with combining a peripheral circuit for RGB video signal outputs. The D-TFD liquid crystal display block is an active matrix LCD with the following features:

- (1) Number of gray scales: Max. 6 bits (64 gray scales / 262,144 colors)
- (2) The interface is available for a digital interface format with 6-bit parallel and RGB serial.
- (3) Image direction reversal function allows horizontal and vertical image reversal. Standard specifications are given for a 6 o'clock viewing angle.

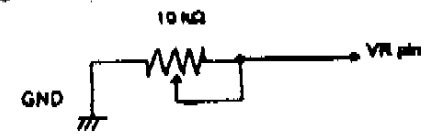
3. Basic Specifications

No.	Item	Specification
1	Outward dimensions	49.6 (W) x 42.5 (H) x 8.8 (D) mm (excluding protuberances)
2	Weight	28 g
3	Screen size	35.568mm(W) x 26.680 mm(H)
4	Number of dots	312 (W) x 230 (H)
5	Dot pitch	114µm (W) x 116µm (H)
6	Color dot arrangement	Delta mosaic
7	Viewing direction	6 o'clock
8	Liquid crystal mode	Transmissive type TN (normally white)
9	Polarizer	Anti-reflection (AR)
10	Polarizer hardness	2H
11	Number of gray scales	Max. 6 bits (64 gray scales, 262,144 colors)
12	Image reversal function	Image can be reversed vertically or horizontally by control signals.
13	Interface format	Digital I/F: 6-bits parallel, RGB serial
14	Light source	A 3-band CCFT (cold cathode fluorescent tube)
15	Backlight brightness	Side-lighting system

4. Block Diagram



5. I/O Pins

No.	Symbol	Function	I/O	Remarks
1	VDD	Power supply for logic and X driver	P	5.0V(Typ.)
2	GND	Ground	P	
3	VCC	(reserved for 3.3V supply)	P	Open for general use (*)
4	D0	Digital video data (LSB)	I	
5	D1	as above	I	
6	D2	as above	I	
7	D3	as above	I	
8	D4	as above	I	
9	D5	as above (MSB)	I	
10	GND	Ground	P	
11	SR	Strobe signal for R data	O	Not use for general input of RGB data according to "7.2(7) RGB data alignment".
12	SG	Strobe signal for G data	O	
13	SB	Strobe signal for B data	O	
14	Hsync	Horizontal sync signal	I	Low active pulse
15	Vsync	Vertical sync signal	I	Low active pulse
16	GND	Ground	P	
17	FIN	Original dot clock	I	750Hz (910Hz clock mode is optional.)
18	X5	Horizontal shift direction selector	I	Low or Open: Forward scanning High: Reverse scanning
19	Y5	Vertical shift direction selector	I	Low or Open: Forward scanning High: Reverse scanning
20	VR	Brightness control terminal	I	Diagram of recommended circuit follows.  Another idea: Apply 0V(bright) to 1.4V(dark) to VR.
21	VEE	LCD drive power supply	P	-32.0V(Typ.)
22	IXSET	(control for internal power sequence)	I	Open for general use.

(*) Optional: It is necessary to change the control board partly.

6. Absolute Maximum Ratings and Environmental Conditions

Item	Symbol	Rating	Unit	Remarks
Power supply voltage	V _{DD}	0 ~ +8.0	V	
	V _{EE}	-35.0 ~ 0	V	
Control signal input voltage	V _{IN}	0 ~ V _{DD}	V	Input pin: following *)
Operating temperature range	T _{OP}	0 ~ 60	°C	Not bedewing
Storage temperature range	T _{ST}	-20 ~ 85	°C	Not bedewing

*) D0-D5, FIN, Hsync, Vsync, XS, YS, IXSET

7. Electrical Characteristics

7.1 DC Characteristics

Item	Symbol	Rating			Unit	Terminals	Remarks
		Min.	Typ.	Max.			
Power supply voltage	V _{DD}	4.75	5.0	5.25	V	V _{DD}	-1)
	V _{EE}	-33.0	-32.0	-31.0	V	V _{EE}	
Input voltage	Low	V _{IL}	0	-	0.6	V	FIN, Hsync, Vsync, XS, YS, D0-D5
	High	V _{IH}	2.7	-	V _{DD}	V	
Input leak current	Low	I _{ILC}	-10	-	-	µA	Excluding pull resistance
	High	I _{IHC}	-	-	+10	µA	
Pull down resistance	R _{PD}	60	180	360	kΩ	XS, YS	
Pull up resistance	R _{PU}	-	4.7	-	kΩ	IXSET	
Power supply current	I _{DD}	-	8	10	mA	V _{DD}	
	I _{EE}	-0.6	-0.4	-	mA	V _{EE}	

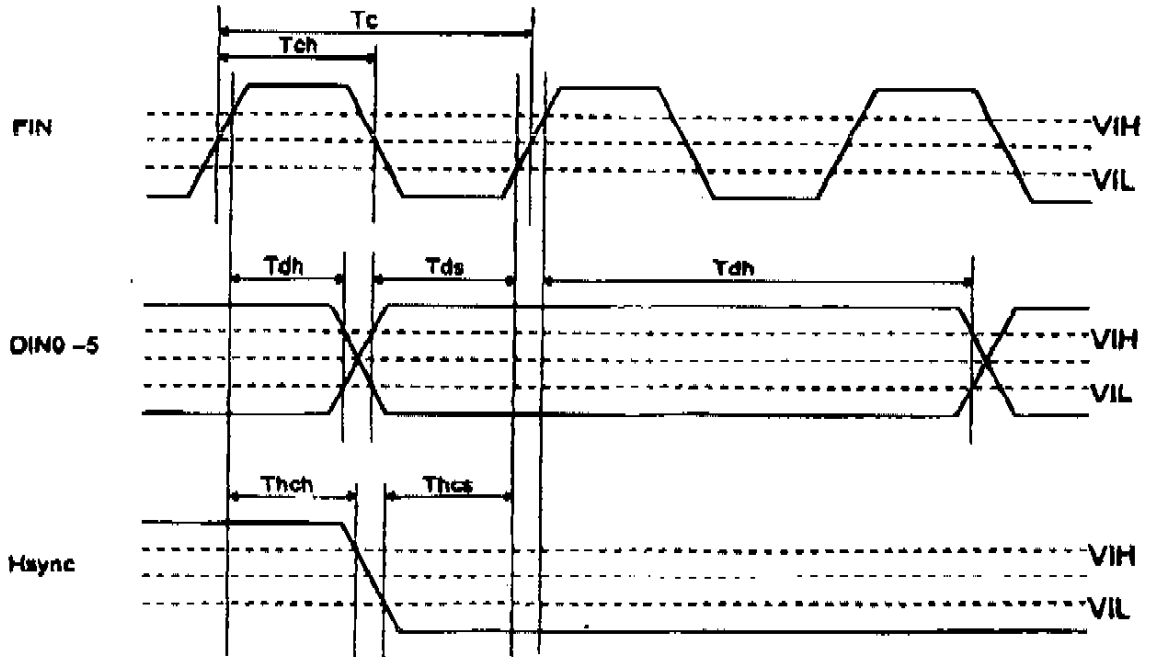
-1) Range of the circuit operation; Electro-optical characteristics depend on V_{DD}=5V, V_{EE}=-32V.

7.2 AC Characteristics

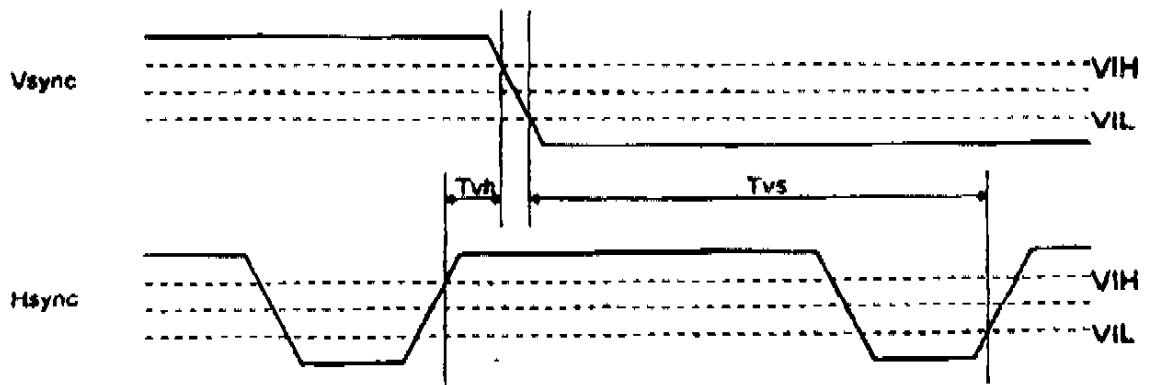
[FIN: 780FH]

Item	Symbol	Rating			Unit	Remarks
		Min.	Typ.	Max.		
FIN frequency	1/Tc	12.1	12.273	12.4	MHz	61.482ns(Typ.)
FIN divided ratio	Tch/Tc	-	0.5	-	-	
Hsync period	Th	-	83.656	-	μ s	15.734kHz(Typ.)
		-	780	-	CLK	
Horizontal valid term	Thd	-	624	-	CLK	
Horizontal front porch	Thf	-	70	-	CLK	
Hsync pulse width	Thp	7	-	60	CLK	
Horizontal back porch	Thb	26	-	79	CLK	
Hsync hold time	Thch	10	-	-	ns	
Hsync setup time	Thcs	10	-	-	ns	
Vsync hold time	Tvh	50	-	-	ns	
Vsync setup time	Tvs	50	-	-	ns	
Vsync period	Tv	-	16.652	-	ms	80.053Hz(Typ.)
		262	262.5	263	H	Tv=Tvb+Tvd+Tvf+Tvp
Vertical valid term	Tvd	-	230	-	H	
Vertical front porch	Tvf	-	9	-	H	
Vsync pulse width	Tvp	3	-3	20	H	Tvp+Tvb=23H
Vertical back porch	Tvb	3	20	20	H	
Data setup time	Tds	6	-	-	ns	
Data hold time	Tdh	6	-	-	ns	

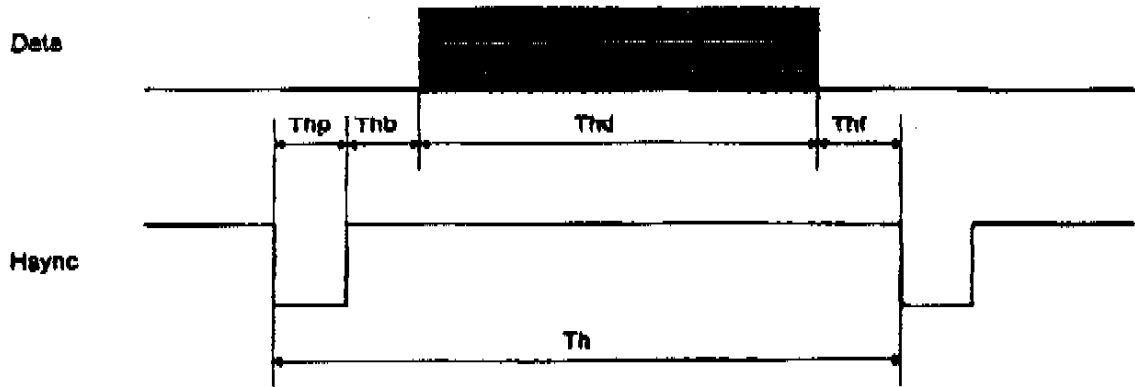
(1) Horizontal logic timings



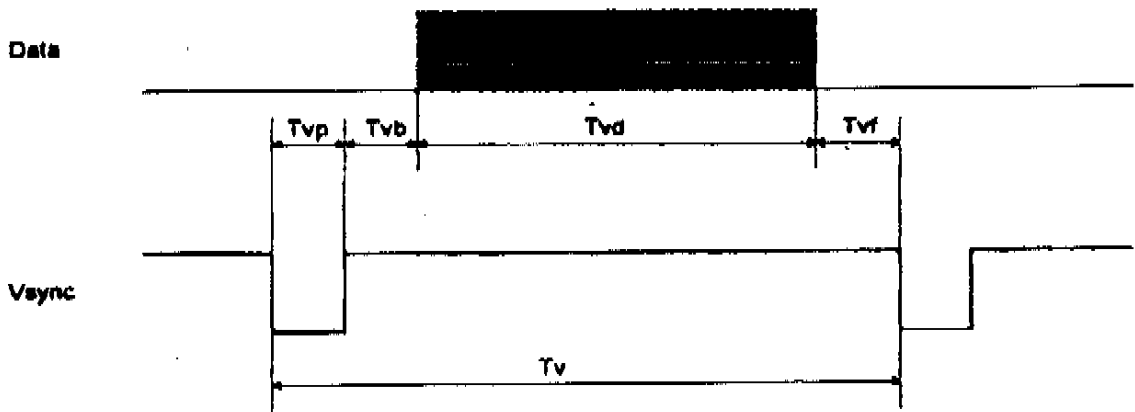
(2) Vertical logic timings



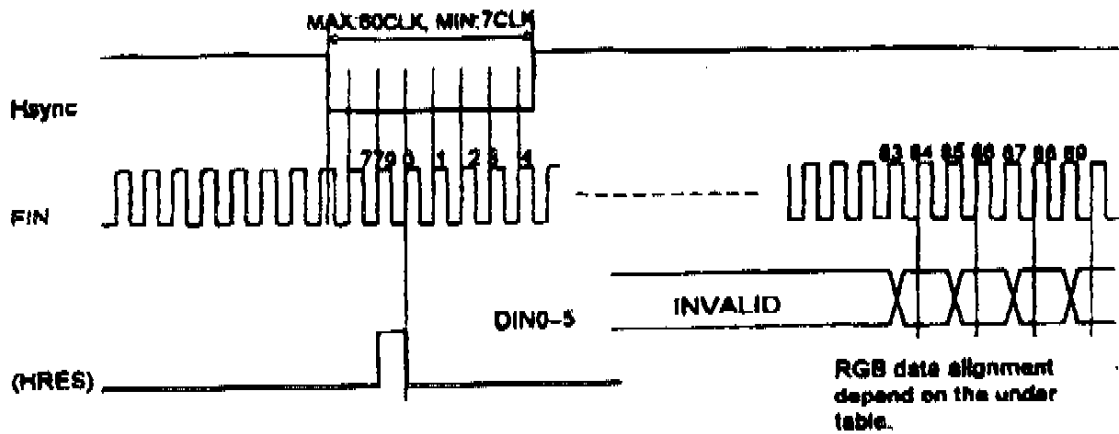
(3) Hsync and data valid term



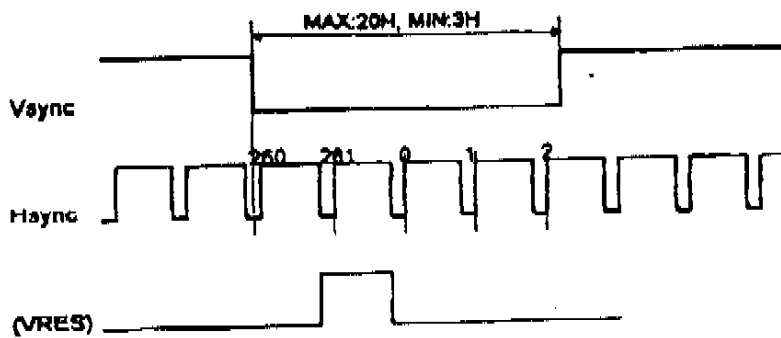
(4) Vsync and data valid term



(5) Horizontal data timings



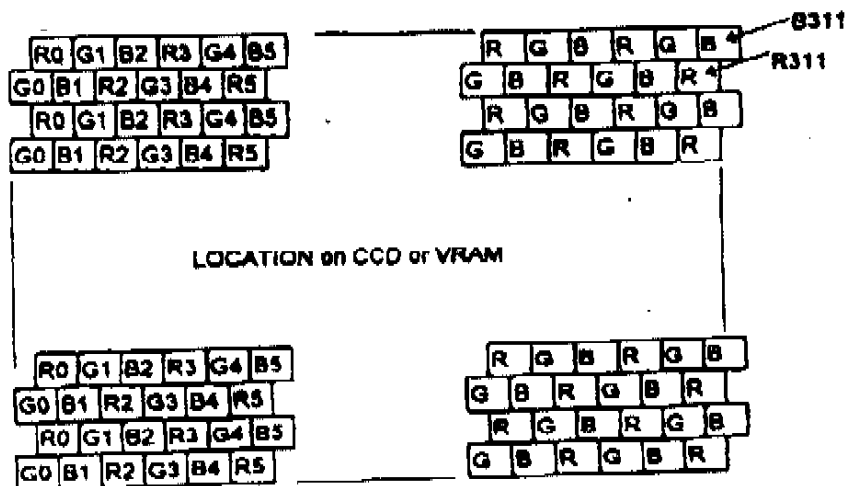
(6) Vertical data timings



(7) RGB data alignment
 N = 1, 3, 5, 7, ..., 228 (N = 1: the top line)

	FIN count	- 83	84	85	88
XS = Low YS = Low	L=N		R0	G1	B2
	L=N+1	INVALID	G0	B1	R2
	L=N+2		R0	G1	B2
XS = Low YS = High	L=N		G0	B1	R2
	L=N+1	INVALID	R0	G1	B2
	L=N+2		G0	B1	R2
XS = High YS = Low	L=N		B0	G1	R2
	L=N+1	INVALID	R0	B1	G2
	L=N+2		B0	G1	R2
XS = High YS = High	L=N		R0	B1	G2
	L=N+1	INVALID	B0	G1	R2
	L=N+2		R0	B1	G2

Pixel arrangement on the LCD panel (accorded with CCD and VRAM)



Supplement

The above figure shows both the color arrangement of LCD and the pixel of CCD that corresponds with the LCD. That is, the corresponding image information as 8-bit signals are stored temporarily in such a RAM to be output with a regular order in accordance with the specification of LCD. And LB16DB has a delta mosaic color arrangement, therefore be careful that the dot of pixel is shifted a half pitch horizontally every line.

This LCD has an image direction reversal function which is able to reverse the right and left and top and bottom. The normal position is as the above figure and the image information is to be writing from the top of the left.

By setting the signal YS(vertical) and/or XS(horizontal) as High or Low, it can change the writing beginning of image information with left-top, right-top, left-bottom, or right-bottom, and as the result it is possible to turn over the image screen up and down, and/or left and right. In this case, the correspondence of the positional relation of the pixel of CCD and the color arrangement of LCD becomes normal or reverse.

The digital image signal input is parallel 8 bits (D0-D5) and D5 is the most significant bit, D0 is the least significant bit. The image information must be loaded to the digital image signal input in accordance with the position order of the pixel arrangement, fundamentally. The color order must be input and change cyclically as the color information of the position, because R, G, B are changing cyclically in the position of the pixel arrangement. In other words, RGB changes like serial.

The timings of the digital image signal input are as P7-P9.

The data are valid vertically in the time of $T_{vp}+T_{vb}=23H$ after the falling edge of V_{sync} (Namely, the data timing of the top line).

When the count of F_{IN} become 84, the image data of the left end is to be output horizontally (Count 0 is 3 counting after the falling edge of H_{sync}). This first timing of data arrangement is shown in the table of (7).

Although if data is input in accordance with the table, there is no problem, beside RGB data strobe signals (SR, SG, SB) can be fed back and select RGB, because they are output signals that indicate the timing of the color selection.

7.3 Power Consumption

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
VDD line	PDD	-	40	53	mW	
VEE line	PEE	-	13	20	mW	

Note: Except CCFT

7.4 Power Supply Sequence

(1) Power-on Sequence

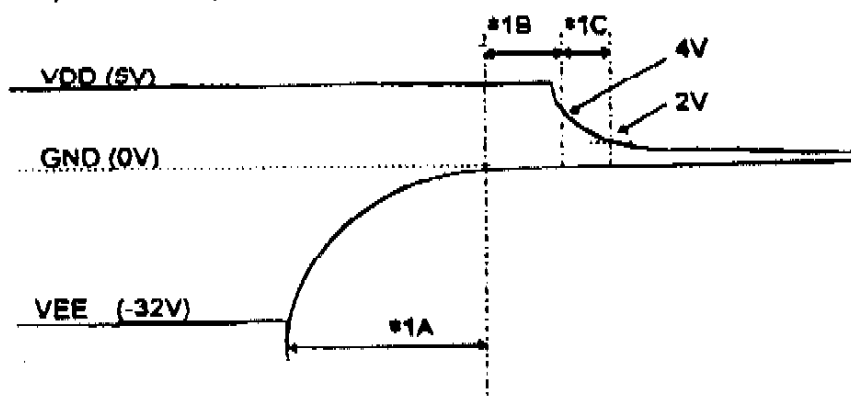
This D-TFD LCD Block is applied both VEE (-32V: voltage for LCD drive) and VDD (5V: voltage for logic). Therefore, if VEE is switched on before VDD, a DC charge is applied in LC, and it is not a good condition.

Then the power-on sequence is to be VDD first and VEE next, or simultaneous.

(2) Power-off Sequence

If VDD is switched off before or simultaneously with VEE, a DC component in LC is not discharged, and it is not a good condition.

Then the power-on sequence is to be as follows.



*1A : Min. 70ms (a time till VEE being -1 V)

*1B : Min. 0ms (a time from VEE being -1 V till logic operation being stopped)

*1C : Max. 50ms (a time from logic operation being stopped till VDD being less than 2 V)

8. Fluorescent Tube Characteristics

Item	Min.	Typ.	Max.	Unit	Remarks
Current	1.0	3.0	3.0	mA	
Voltage	-	190	-	V(rms.)	
Operating lifetime	10000	-	-	hour	(Note)
Minimal discharge stable voltage	0°C	470	-	V(rms.)	> discharge start voltage
	25°C	400	-	V(rms.)	
Minimal driving frequency	50	50	-	kHz	

(Note) Operating lifetime means a sum of lightening times till one or more of the following 4 items.

- 1) Luminance on the tube surface becomes 60% lower than its initial rate.
- 2) Discharge voltage becomes 110% higher than its initial rate.
- 3) It can not brighten.
- 4) Other remarkable visual defect happens.

9. Electro-optical Characteristics

The values below refer to the panel module, at temperature on its surface. It is driven with V_{DD}=5.0V and V_{EE}=-32.0V.

Item	Symbol	Typ.	Unit	Condition	
Luminance	25°C, Center of display	L _{typ}	200	cd/m ² (Note)	
Contrast ratio	25°C	CR ₂₅	150	ratio (Note)	
	50°C	CR ₅₀	120		
	80°C	CR ₈₀	40		
Viewing angle	50°C	φ=90° (12 O'clock)	YU	more than 15	degree (θ) (Note)
		φ=270° (6 O'clock)	YD	more than 20	
		φ=0° (3 O'clock)	XR	more than 50	
		φ=180° (9 O'clock)	XL	more than 50	
Response time	0°C	Turn-on time	ton0	60	msec (Note)
		Turn-off time	toff0	170	
	25°C	Turn-on time	ton25	30	
		Turn-off time	toff25	60	
Chromaticity	Room temperature including backlight	Color	x	y	(CIE) (Note)
		R	0.565	0.355	
		G	0.280	0.580	
		B	0.140	0.145	
		W	0.290	0.345	

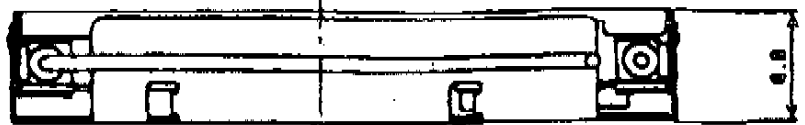
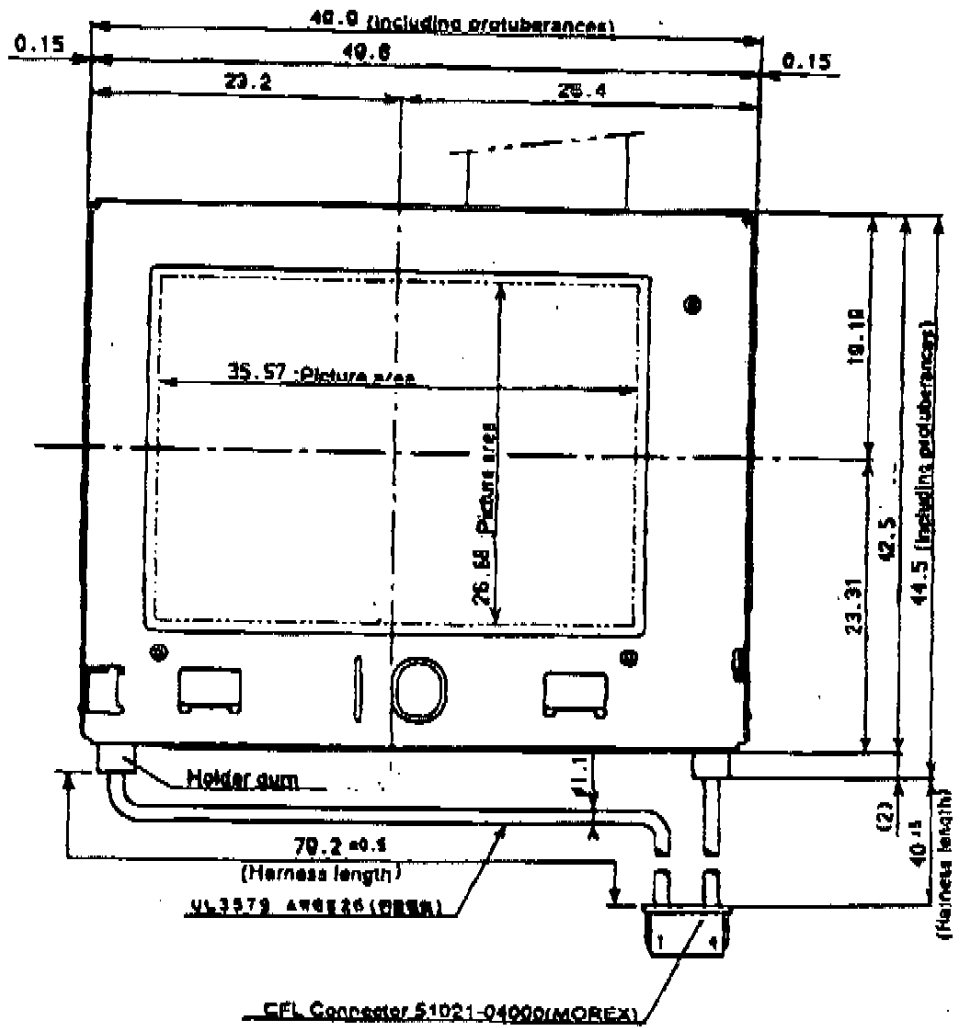
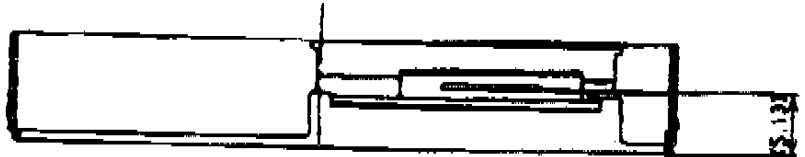
Note: Measuring condition depends on Seiko Epson Standard.

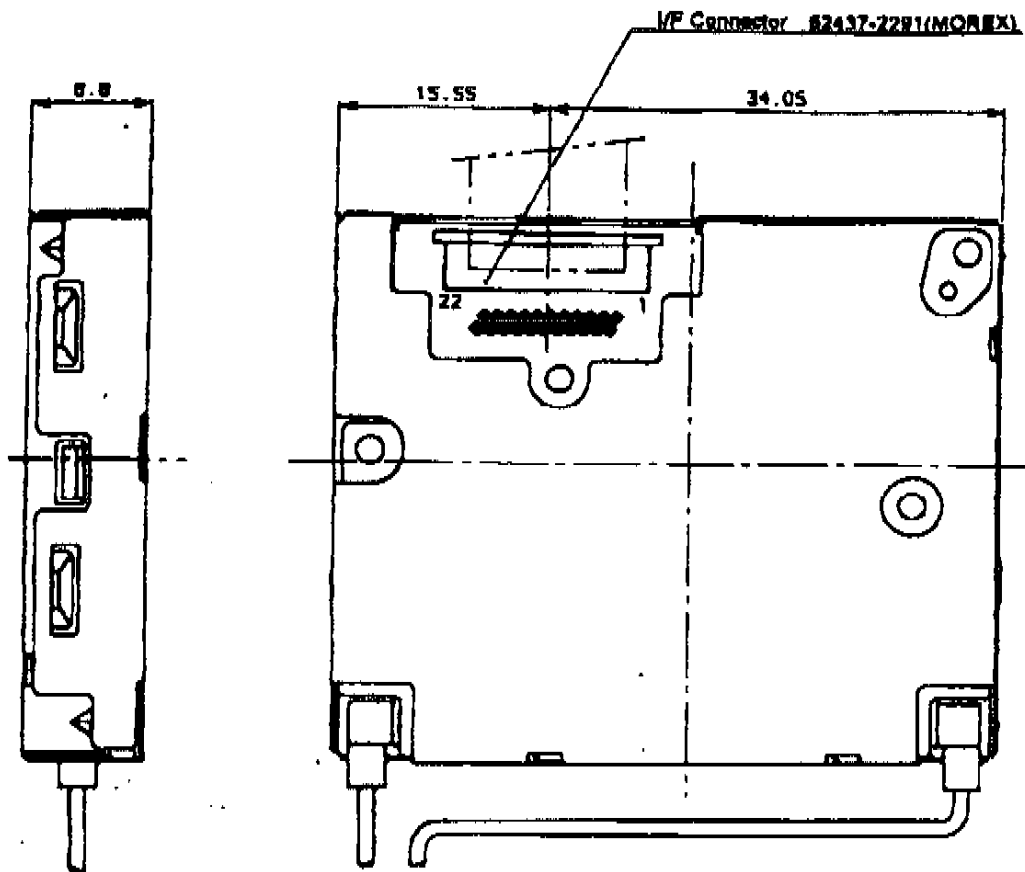
10. Environmental and Endurance Test Items

No.	Item	Condition	Rating	Evaluation criterion	
1	High-temperature storage	85°C ± 2°C	500 h	All 'Display Specifications' in the product specification must be met after test. Before starting the test, keep the unit for one hour at room temperature.	
2	Low-temperature storage	-20°C ± 2°C	500 h		
3	Heat cycle	-20°C ↔ 25°C ↔ 85°C (1 h) (10 min) (1 h)	100 cycles		
4	High-temperature operation	80°C ± 2°C	200 h		
5	Low-temperature operation	0°C ± 2°C	200 h		
6	Damp heat operation	60°C 90%	200 h		
7	Static electricity characteristics	Panel	100pF, 150Ω, 20~25°C, 80%RH	15kV	Freedom from major defects of 'Display Appearance Standard' in the product specification.
		Connectors	100pF, 0Ω, 20~25°C, 80%RH	200V	
8	Polarizer chemicals resistance	Wipe with gauze soaked in alcohol.	100 times	Appearance must not be impaired after test.	
	Polarizer abrasion resistance	Cover tip of a bar (1 cm dia.) with four layers of rough cotton and rub with a pressure of 200 gV.	200 times		
9	Package drop shock	According to JIS-Z0202 Height for plane drop: 50 cm Height for corner line drop: 30 cm		Both 'General Appearance Standard' and 'Display Appearance Standard' in the product specification must be met.	
10	Package vibration resistance	10 - 55 Hz, 1 cycle with 1 min, 1.5 G 20 min each in X, Y, Z direction.			
11	Shock resistance	Apply a half-sine 80 G shock of 8 ms duration to panel block in X and Y direction. Do not apply shock directly to panel.			
12	Tensional strength of backlight wires	Wires should withstand application of 400 g tension of duration 40 sec.			

11. Handling Instructions

- (1) Take precautions against static electricity when handling the panel block. (Ex.: Using the earth band and the ionizer)
- (2) The front side of the polarizer is covered by a protective sheet before shipping. Remove the sheet immediately before installing the product.
Take precautions against static electricity, such as (1) described above, when removing the polarizer.
- (3) The polarizer surface scratches very easily. Do not touch it with your bare hands or other objects. Wipe it using the cotton bar with little ethyl alcohol or IPA, when hardly dirtied. Take off dust on its surface using a blower.
- (4) Handle the panel block with holding its shield plate. Do not hold either the BL harness or the LCD screen. Because, if the BL harness is pulled, BL would happen not to brighten, and if the LCD screen is pushed, something visibly unusual would occur.
Do not bend or twist the panel block.
- (5) Note of an environment of use;
It is a cause of failure of LCD to leave it bedewing and drive it in a damp heat. In that case, drive it after keeping in a room temperature at least 30 minutes.
- (6) Note of a keeping;
Keep the LCD at a cool and dark ventilated place, avoiding high humidity, high temperature and direct sun shine.
- (7) Note of a fixed picture pattern;
Do not display a fixed picture pattern on LCD, when doing a aging test etc.. And avoid to display a fixed picture pattern for long time. The phenomenon of image persistence would happen possibly under LC characteristics.
- (8) Note of a disposal;
In the case of the disposal of this LCD, it is better to charge a special trader with it .for the eco-activity.





Pins of VF connector

No.	Name
1	VDD
2	GND
3	(VCC)
4	D0
5	D1
6	D2
7	D3
8	D4
9	D5
10	GND
11	SR
12	SG
13	SB
14	HSYNC
15	VSYNC

Pins of CFL connector

No.	Name
1	COLD(White)
2	NC
3	NC
4	HOT(Red)

16	GND
17	FIN
18	XS
19	YS
20	VR
21	VEE
22	IXSET

LB18DB-8D series MPI98021-01E

OUTWARD DWG.