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To :

Specification of FUJITSU TFT-LCD module

FLC38XGC6V-04 -old pt #

NA19020-C053 new pt #

Approval
Date :
By :

Specification No. : Tech Bes 98/27972

Issue Date : May 17, 1999

Issued by : T. Naka

T. Naka

Director
LCD Design Dep.
LCD Technology Div.
LCD Group

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Revision history

Revision	Date	Prepared	Checked		Approved	Summary
21H	Aug. 18. 1998	T. Minemura		T. Minemura	T. Naka	Characteristic improvement
22H	May 17. 1999	M. Miyahara	M. Miyahara	T. Minemura	T. Naka	Design Change of LCD driver
23I	May 17. 1999	M. Miyahara	M. Miyahara	T. Minemura	T. Naka	Design Change of timing IC

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NO.	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
05	990517	M. Miyahara		Change pl. 22~24	F. Yamada

DESIG. 980818 T. Minemura CHECK

TITLE: FLC38XGC6V-04

DRAW. NO.: Tech Bes 98/27972 CUST.

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TABLE OF CONTENTS

DOCUMENT CONTROL SECTION

DATE

TITLE	FLC38XGC6V-04	
DRAW. NO.	Tech Bes 98/27972	CUST.
FUJITSU LIMITED		2 /

DIT.	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
DESIG.			CHECK		

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1. APPLICATIONS

This specification is applied to the 15.0 in. XGA supported TFT-LCD module.

2. PRODUCT NAME AND MODEL NUMBER

2-1 Product Name : LCD Module

2-2 Model Number : FLC38XGC6V-04

3. OVERVIEW

This LCD module has a TFT active matrix type liquid crystal panel 1024x768 pixels, and diagonal size of 38cm(15.0-inch). This module supports 1024x768 XGA mode(Non-interlace). This LCD has a digital RGB interface and can display 262,144 colors.

In addition to "Horizontal synchronize signal:Hsync" and "Vertical synchronize signal:Vsync", this module can be controled by "Data enable signal:ENAB", which is able to control video signal timing without Hsync and Vsync.
(Data enable mode)

Even and odd data are transmitted at the same timing in the interface, so data lines are 36.(R,G,B each 6 bit x2) The signal level of this interface is +3.3V CMOS level or 5V TTL level.

The power supply of this LCD module is +5V DC single.

This module has the characteristics for applying TCO'95.

4. CONFIGURATION

This LCD module consists of a color TFT-LCD panel that is mounted with TFT driver ICs, a cold-cathode fluorescent tube back-light, and a RGB digital interface board
The inverter for the back-light is not included.
Figure 4-1 shows a block diagram of this LCD module.

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DATE

DIT.	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
DESIG.			CHECK		

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DRAW. NO. Tech Bes 98/27972 CUST.

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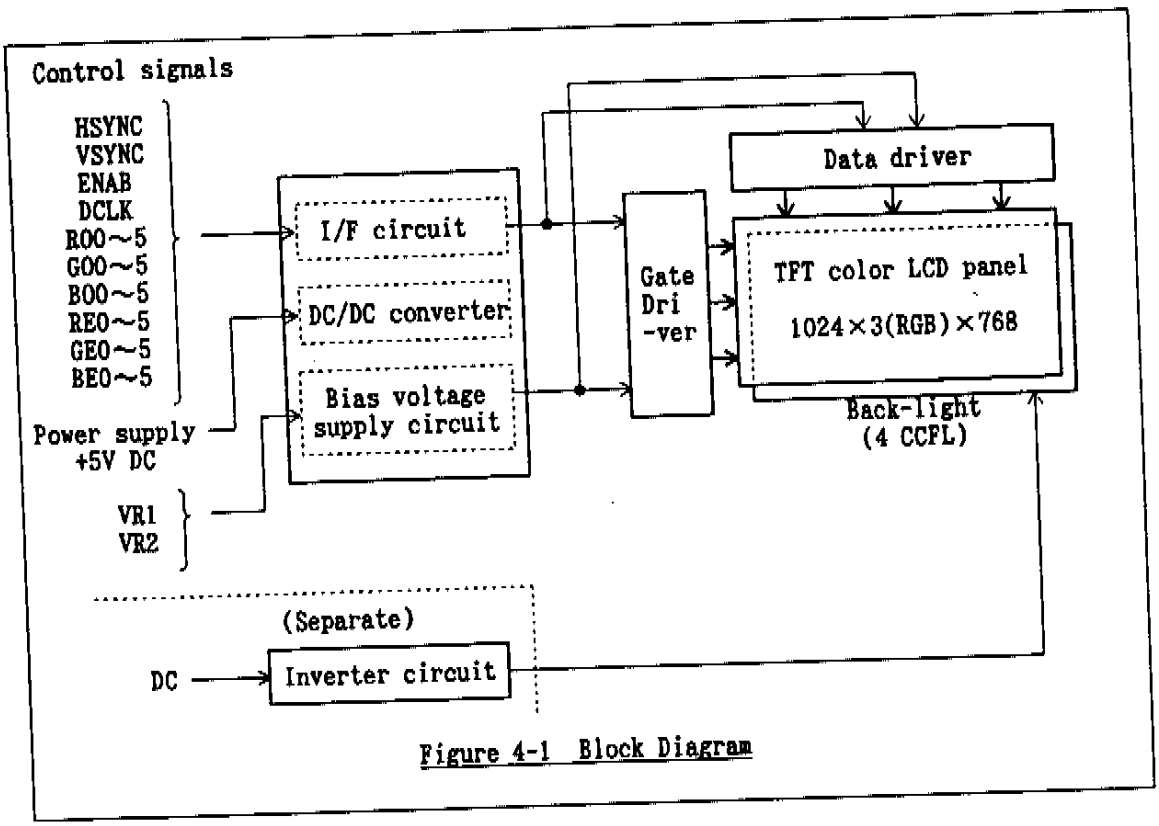

Figure 4-1 Block Diagram

5. MECHANICAL SPECIFICATIONS

Table 5-1 shows the mechanical specifications of this LCD module.

Table 5-1 Mechanical Specifications

Item	Specifications	Unit	Remark
Dimensions	347.3 ×263.5 ×16.5 (TYP) (Excluding I/F Connector and fixing parts)	mm	Edge type back-light is used. (φ2.6 CCFL×4)
Display Resolution	(1024 ×3)×768	—	Without a inverter.
Display Dot Area	304.1 ×228.1	mm	For details on dimensions, see Dimensional Outline Drawing. (at page 29,30)
Dot Pitch	(0.099×3)×0.297	mm	
Aspect Ratio	1 : 1	—	Excluding inverter.
Weight	1,900 max	g	
FG-SG	short circuit	—	——

DOCUMENT CONTROL SECTION

DATE

TITLE	FLC38XGC6V-04	
DRAW. NO.	Tech Bes 98/27972	CUST.
FUJITSU LIMITED	SHEET	4 /

NO.	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
DESIG.			CHECK		

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6. ABSOLUTE MAXIMUM RATING

Table 6-1 shows the absolute maximum rating of this LCD module.

Table 6-1 Absolute Maximum Rating

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	Ta=25℃	-0.3	—	6.0	V
Input Voltage	V_{IN}	Ta=25℃	-0.3	—	V_{CC}+0.3	V

7. ELECTRICAL SPECIFICATIONS

Table 7-1 shows the recommended operating conditions of this LCD module.

Table 7-1 Recommended Operating Conditions

Item		Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage (Logic)		V_{CC}	4.75	5.0	5.25	V
Ripple Voltage	Vcc	V_{RP}	—	—	100	mV

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DATE

MT	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
DESIG.			CHECK		

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DRAW. NO. Tech Bes 98/27972 CUST.

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8. ELECTRICAL SPECIFICATIONS

Table 8-1 shows the electrical specifications of this LCD module. Figure 8-1 shows the measurement circuit. Figure 8-2(A) shows the equivalent circuit of the logic signal input area. Figuer 8-2(B) shows the equivalent circuit of the supply voltage input area.

Table 8-1 Electrical Specifications

Item		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark
Supply Current ②		Icc	Vcc= +5.0±0.25V Vss=0V DCLK=32.505MHz	–	320	700	mA	*1
"H" Level Logic Input Voltage		VIH		2.3	–	Vcc	V	
"L" Level Logic Input Voltage		VIL		Vss	–	0.9	V	
④Leak Current(Logic Input)		IIL		-5	–	+5	μA	
Supply Rush Current ②		Iscc		–	–	5.5	A	*2
Supply Rush Current Duration(1A excess) ②		Tscc		–	–	0.4	ms	
Contrast Regulation VR		RVR		0	–	100	kΩ	
BACK LIGHT *4	CCFL Turn on Voltage ②	Vs	fL=50kHz, Ta=25℃	–	1324	1500	Vrms	
			fL=50kHz, Ta=0℃	–	–	1500		
	Lighting Voltage ②	VL	fL=50kHz IL= 7mA	550	580	610	Vrms	
	Lighting Frequency	fL	VL=580Vrms	40	50	60	kHz	
	Tube Current ②	IL	fL=50kHz VL=580Vrms	6	7	8	mA	*4

②(*1) Typical current situation: Color bar pattern. Vcc=5.0V
Maximum current situation: 2-pixel checker pattern. Vcc=4.75V
Without rush current.

(*2) These items prescrebe the rush current for starting internal DC/DC.
Charging current to capacitors of Vcc is not prescribed.

②(*3) Back-light specifications are valid shen using a suitable inverter such as the "HIU-390"(FLCV-06) of HARISON ELECTRIC CO.,LTD.

(*4). Tube Current (IL) shows the value of the current that is consumed at one lamp.
④ This LCD module has 4 lamps. Each 2 lamps are placed at upper side and lower sid of the display. 2 lamps is connected in parallel. Each low voltage terminals are connected with 1 line cable to Back-light connecter.

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DATE	DESIG.	CHECK	DESCRIPTION
04 990405			Add ④spec.
02 981028			Specified ② spec.

TITLE FLC38XGC6V-04
DRAW. NO. Tech Bes 98/27972
CUST.
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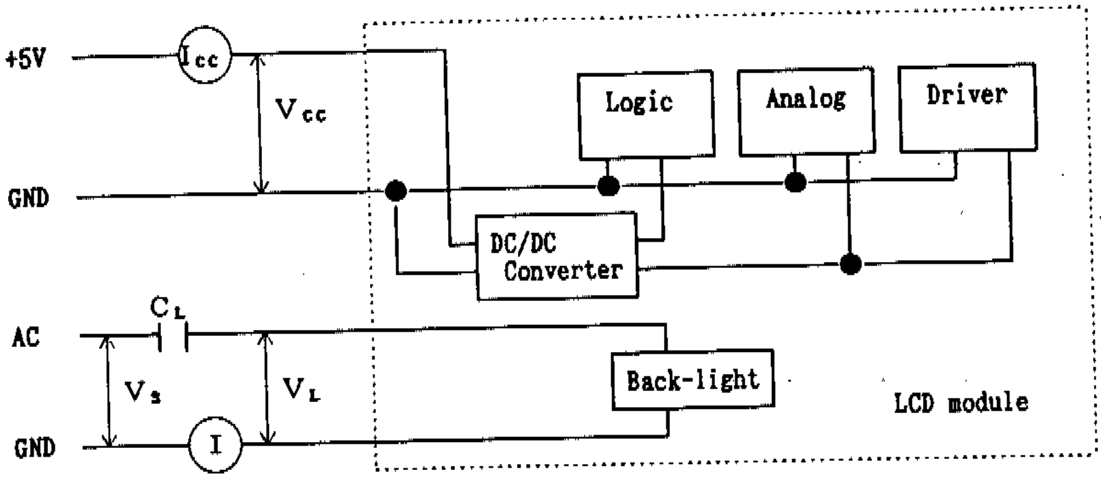
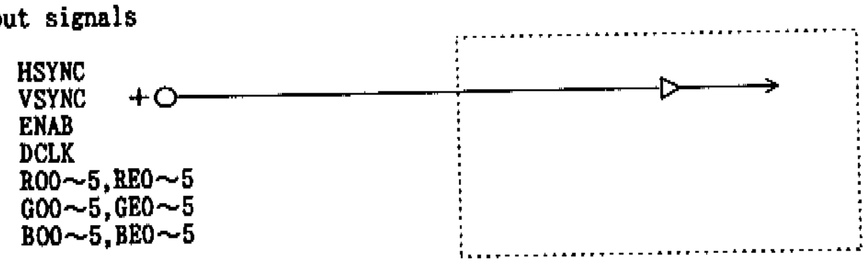
Measurement circuit is based on Figure 8-1.

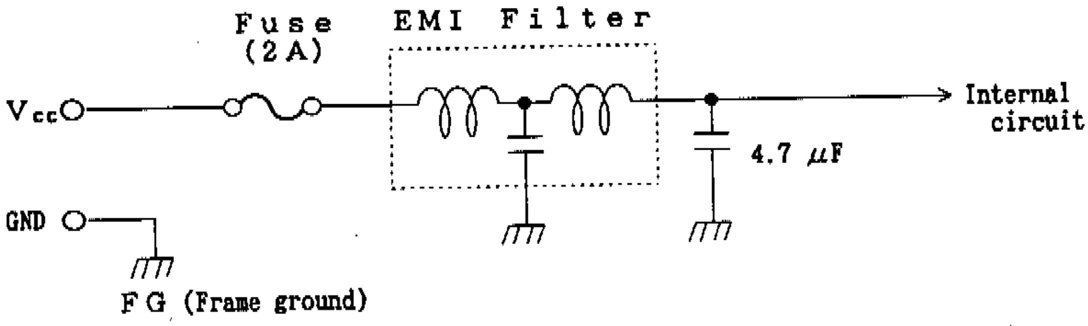


② Figure 8-1 Measurement circuit

Input signals



② Figure 8-2(A) Equivalent circuit of logic signal input



Fuse ········· F0805B2R00FWTR (KYOCERA CORPORATION)
EMI Filter ··· KNH21104 (KYOCERA CORPORATION)

② Figure 8-2(B) Equivalent circuit of power supply

DOCUMENT CONTROL SECTION

DATE

TITLE	FLC38XGC6V-04	
DRAW. NO.	Tech Bes 98/27972	CUST.
FUJITSU LIMITED	SHEET	7 /

EDT. DATE DESIG. CHECK DESCRIPTION
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9. OPTICAL SPECIFICATIONS

Table 9-1 shows the optical specifications of this LCD Module.

Table 9-1 Optical Specifications

Ta=25℃

Item		Simbol	Condition		Specifications MIN.	TYP.	MAX.	Unit	Remark	Note
Visual Angle ②	Horizontal	$\theta_{L,R}$	CR≧10	$\theta_{U,D}$=0°	80	–	–	deg		(1)(2)(3)(5)(6)
	Vertical	$\theta_{U,D}$		$\theta_{L,R}$=0°	80	–	–	deg		
Contrast Ratio ② ④		CR	$\theta_{L,R}$ $\theta_{U,D}$ =0°	(R_{VR}=100k)	210	300	–	–	White/ Black	(1)(2)(3)(5)
				(R_{VR}=100k)	190	270	–			
Response Time (ON) (B→W)		t_{on}	$\theta_{L,R}$ $\theta_{U,D}$ =0°	Ta=25℃	–	15	30	ms		(1)(4)(5)
				Ta= 0℃	–	50	100	ms		
Response Time (OFF) (W→B)		t_{off}	$\theta_{L,R}$ $\theta_{U,D}$ =0°	Ta=25℃	–	10	25	ms		
				Ta= 0℃	–	50	100	ms		
Brightness ②		I	$\theta_{L,R,U,D}$=0° V_{CC}=5v, I_L=7mA (@ Maximum Brightness)		200	250	–	cd/㎡	White *1	(1)(5)
Brightness Uniformity		ΔI			80	–	–	%		(1)(5)(7)
Chromaticity ④	W	x			0.283	0.313	0.343	–		(1)(5)
		y			0.299	0.329	0.359	–		
	R G B	(x,y)		Red	(0.600, 0.342) Typ.					
				Green	(0.295, 0.571) Typ.					
				White	(0.148, 0.112) Typ.					
LCD Panel Type					TFT Color					
Display Mode					Normaly Black VA					
Wide Viewing Angle Technology					MVA					
Optimum Viewing Angle					– (symmetry)					(6)
Display Color					262,144 (6-bit color)					
Color of non-display area					Black					
Surface Treatment					Anti-glare(Haze value:30%,2H(at 300gf load)					

(*1) Value at 15~20 minutes after lighting on.

(Note) · CS-1000(MINOLTA Co.,Ltd.), BM-5A(Topcon) and the like should be used as a luminance colorimeter. Field=2°, L=500mm

④ · Back-light current = 7mA, R_{VR}=100k, Dark room condition (1 lux or less)

④ · Omitting R_{VR} is possible. In that case, CR value is nearly equal at R_{VR}=100k.

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DATE	MK.	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
	04	990405			Add ④ Spec.	
	02	981028			Specified ② Spec.	

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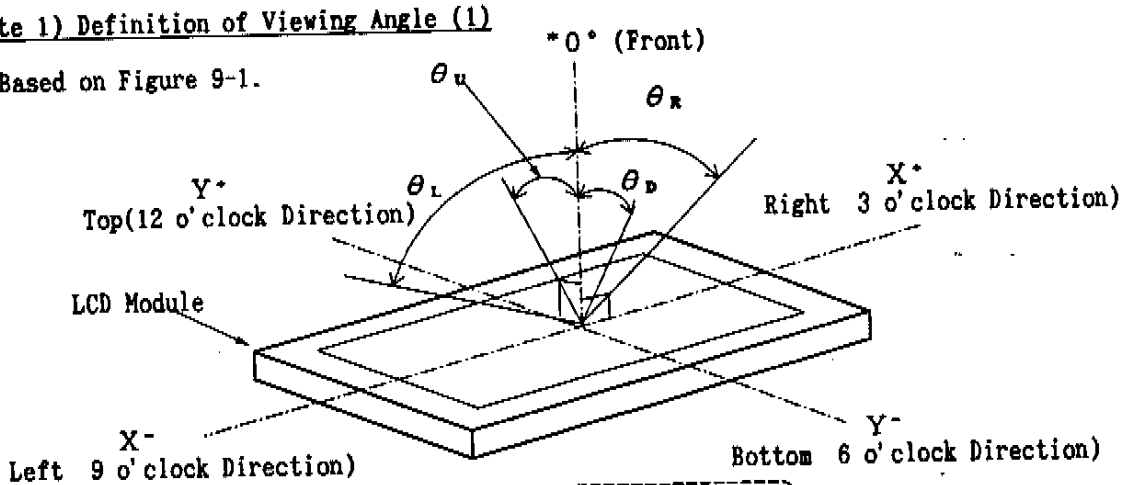
Note 1) Definition of Viewing Angle (1)

Based on Figure 9-1.



*→ $\theta_U = 0°$, $\theta_D = 0°$, $\theta_L = 0°$, $\theta_R = 0°$

Figure 9-1 Definition of Viewing Angle (1)

Note 2) Definition of Viewing Angle (2)

Based on Figure 9-2.

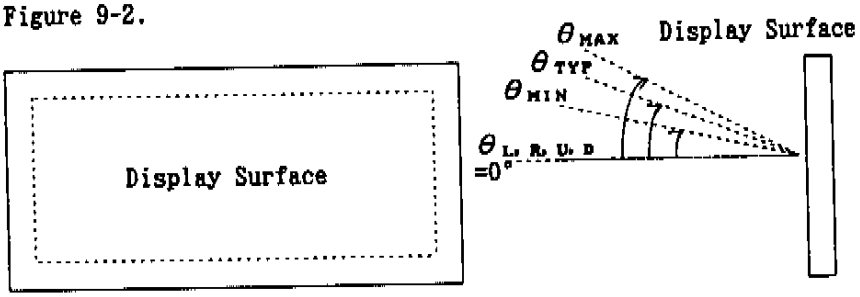


Figure 9-2 Definition of Viewing Angle (2)

Note 3) Definition of Contrast Ratio(CR)

Determined by Formula(1) based on Figure 9-3 Voltage-Brightness Characteristics

$$= \frac{L_W \text{ (Brightness at white)}}{L_B \text{ (Brightness at black)}} \quad \cdots\cdots (1)$$

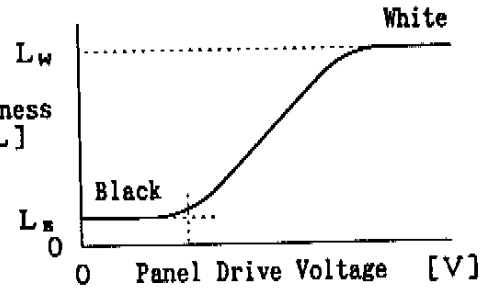


Figure 9-3 Voltage-Brightness Characteristics

DOCUMENT CONTROL SECTION

DATE	DESIG.	CHECK	DESCRIPTION	APPR.

TITLE FLC38XGC6V-04
DRAW. NO. Tech Bes 98/27972
CUST.
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9

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Note 4) Definition of Response Time

Based on Figure 9-4.

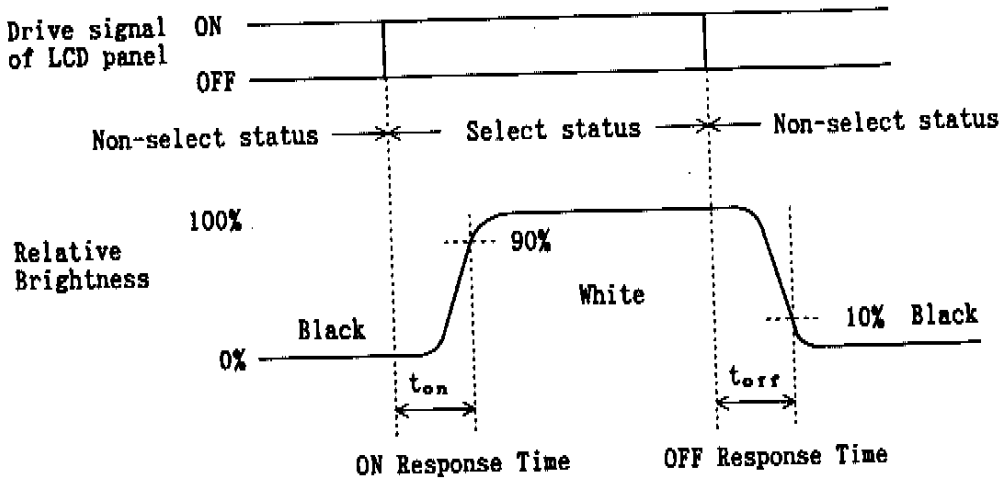

Figure 9-4 Definition of Response Time

Note 5) Contrast Ratio and Response Measurement System

Based on Figure 9-5.

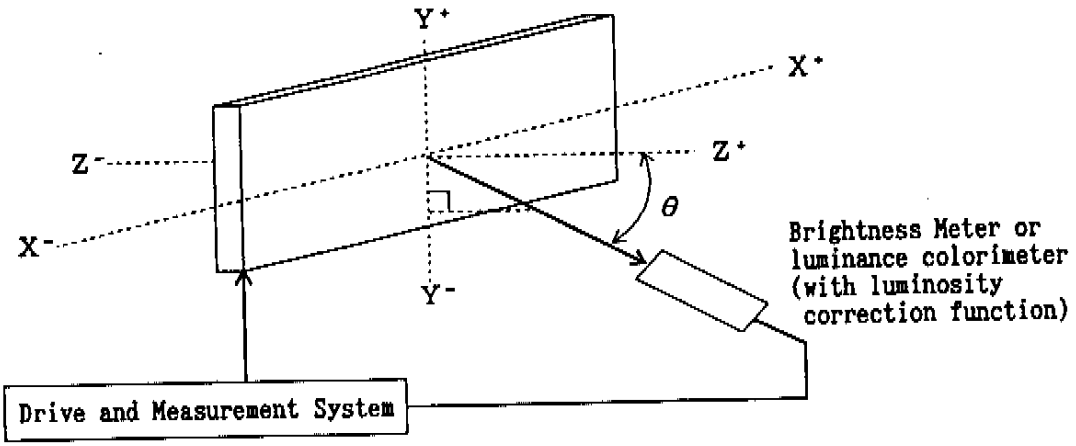

Figure 9-5 Contrast Ratio and Response Time Measurement System

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DATE

MT	DATE	DESIG.	CHECK	DESCRIPTION	APPR.
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TITLE FLC38XGC6V-04

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Note 6) Definition of Optimum Viewing Angle

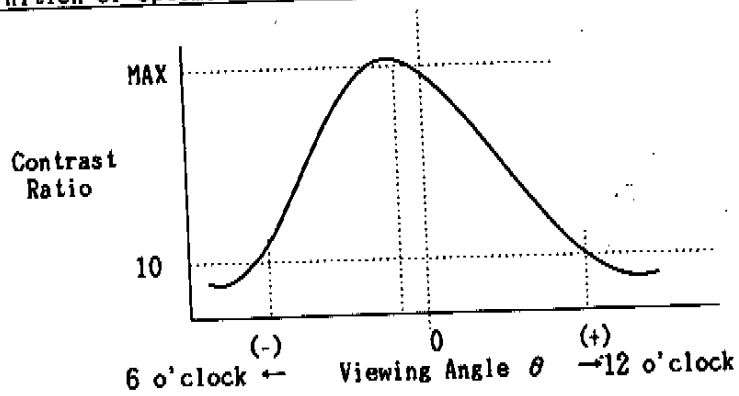
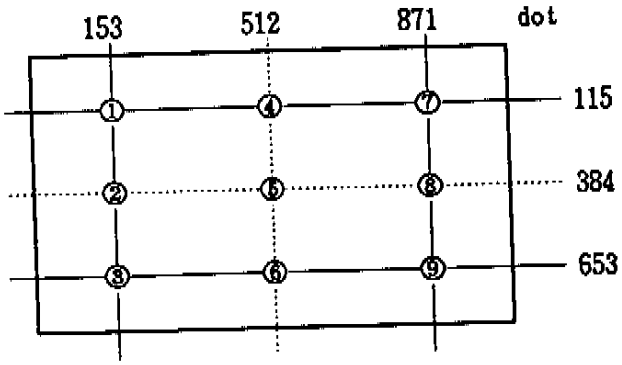


Figure 9-6 Definition of Optimum Viewing Angle

Note 7) Definition of Brightness Uniformity

Brightness uniformity is defined by the following formula. Brightness (I1~I9) are measured at the following 9 points (①~⑨) on the display area that is shown in Figure 9-7.

$$\text{Brightness Uniformity}(\Delta L) = \frac{|\text{Min.In}|}{|\text{Max.In}|} \times 100\ (\%),\quad n=1 \text{ to } 9$$



Note) Each measurement point (①~⑨) defines the center spot of view of Brightness Meter. The tolerance of measurement position is ±5 mm. ④

Figure 9-7 Measurement Points

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DATE	DESIG.	CHECK	DESCRIPTION	APPR.
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DRAW. NO. Tech Bes 98/27972
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10. INTERFACE SPECIFICATIONS

10-1 Signal descriptions

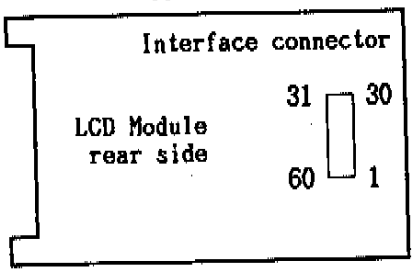
Table 10-1 shows the description and configuration of interface signals(CN1).

Table 10-1 Interface signals(CN3)

Pin No.	Symbol	I/O	Function	Pin No.	Symbol	I/O	Function
1	GND	—	Ground	31	GO1	I	Green odd data 1
2	RE0	I	Red even data 0	32	GO2	I	Green odd data 2
3	RE1	I	Red even data 1	33	GO3	I	Green odd data 3
4	RE2	I	Red even data 2	34	GO4	I	Green odd data 4
5	RE3	I	Red even data 3	35	GO5	I	Green odd data 5
6	RE4	I	Red even data 4	36	GND	—	Ground
7	RE5	I	Red even data 5	37	BO0	I	Blue odd data 0
8	GND	—	Ground	38	BO1	I	Blue odd data 1
9	GE0	I	Green even data 0	39	BO2	I	Blue odd data 2
10	GE1	I	Green even data 1	40	BO3	I	Blue odd data 3
11	GE2	I	Green even data 2	41	BO4	I	Blue odd data 4
12	GE3	I	Green even data 3	42	BO5	I	Blue odd data 5
13	GE4	I	Green even data 4	43	GND	—	Ground
14	GE5	I	Green even data 5	44	VSYNC	I	Vertical Synchronizing signal
15	GND	—	Ground	45	HSYNC	I	Horizontal Synchronizing signal
16	BE0	I	Blue even data 0	46	ENAB	I	Pata enable signal
17	BE1	I	Blue even data 1	47	GND	—	Ground
18	BE2	I	Blue even data 2	48	GND	—	Ground
19	BE3	I	Blue even data 3	49	DCLK	I	Dot clock signal
20	BE4	I	Blue even data 4	50	GND	—	Ground
21	BE5	I	Blue even data 5	51	GND	—	Ground
22	GND	—	Ground	52	VR1	—	Contrast regulating VR1
23	RO0	I	Red odd data 0	53	VR2	—	Contrast regulating VR2
24	RO1	I	Red odd data 1	54	GND	—	Ground
25	RO2	I	Red odd data 2	55	GND	—	Ground
26	RO3	I	Red odd data 3	56	GND	—	Ground
27	RO4	I	Red odd data 4	57	VDD	—	+5v Power supply
28	RO5	I	Red odd data 5	58	VDD	—	+5v Power supply
29	GND	—	Ground	59	VDD	—	+5v Power supply
30	GO0	I	Green odd data 0	60	VDD	—	+5v Power supply

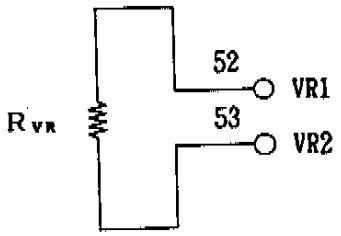
Connector : 52760-0600(Molex) User's connector : 53475-0600(Molex)

Upper side



Lower side

Contrast regulating VR: R_{VR}(100kΩ)



④ Omitting R_{VR} is possible.
In this case, CR value is nearly equal at R_{VR} =100kΩ.

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DATE	DESIG.	CHECK	DESCRIPTION	APPR.
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10-2 Color Data Assignment

Table 10-2 shows the Color Data Assignment.

Table 10-2 Color Data Assignment

Color		R input data						G input data						B input data					
	Odd / Even	RO5 / RE5	RO4 / RE4	RO3 / RE3	RO2 / RE2	RO1 / RE1	RO0 / RE0	GO5 / GE5	GO4 / GE4	GO3 / GE3	GO2 / GE2	GO1 / GE1	GO0 / GE0	BO5 / BE5	BO4 / BE4	BO3 / BE3	BO2 / BE2	BO1 / BE1	BO0 / BE0
Basic color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	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	0
	⇧ 1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	⇧ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	⇩ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	brighter 61	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	⇩ 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	0
	⇧ 1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	⇩ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	brighter 61	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0
	⇩ 62	0	0	0	0	0	0	1	1	1	1	1	1	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	0
	⇧ 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	⇧ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	⇩ :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	brighter 61	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	⇩ 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)···· n indicates gray scale level.
Larger number n means brighter level.

Note.2) Data; 1:High, 0:Low

Note.3) Color data consist of 6 bit red, green and blue data of odd and even number pixel data. Total data number is 36 signals. this module is able to display 262,144 colors because each red, green and blue data is controlled independently.

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10-3 Input Signal Timing

Table 10-3 and Figure 10-2 shows the Input Signal Timing.

Table 10-3 Timing Characteristics (T=0~50℃, Vcc=5±0.25V)

Item		Simbol	Min.	Typ.	Max.	Unit	Remark
DCLK signal (Clock)	Period	Tc	④25.000	30.764	40.000	ns	
	Frequency	1/Tc	25.000	32.505	40.000	MHz	
	Duty	Tch/Tc	40	50	60	%	
④	High time	TclkH	5.0	—	—	ns	
④	Low time	TclkL	5.0	—	—	ns	
④	Rise time	Tclkr	—	—	5.0	ns	
④	fall time	Tclkf	—	—	5.0	ns	
DCLK-Data timing	Set up time	Tset	4.5	—	—	ns	40MHz
	Hold time	Thold	6.5	—	—	ns	40MHz
Hsync signal	Period	Th1	660*2	672	1566 *2	DCLK	ENAB Invalid
	Period	Th2	565*2	672	1566 *2	DCLK	ENAB Valid
Ⓢ	Frequency	1/Th	—	48	60	kHz	
	Pulse width	Thp	2*2	68	—	DCLK	*1,2
	Back-porch	Thb	0	80	Th-Thp-512	DCLK	*1,2
	Display period	Thd	—	512	—	DCLK	*3
	Front-porch	Thf	—	12	—	DCLK	*1,2
Vsync signal	Period	Tv	772*2	806	868 *2	Th	16.67 ms
	Frequency	1/Tv	—	Ⓢ60	Ⓢ 75	Hz	
	Pulse width	Tvp	4*2	6	—	Th	*1,2
	Back-porch	Tvb	0	29	Tv-Tvp-768	Th	*1,2
	Display period	Tvd	—	768	—	Th	*3
	Front-porch	Tvf	—	3	—	Th	*1,2
	Hsync-Vsync timing	Tvh	1	Thp	Th-Thp	DCLK	
ENAB signal	Hsync-ENAB timing	—	—	—	—	DCLK	*1
	Data-ENAB timing	Tdn	—	0	—	DCLK	*4

*1) ・When ENAB(Data Enable Signal)is valid, horizontal display position is specified by the rise of ENAB. The data latched at falling edge of DCLK after rise of ENAB is displayed at the left edge of the display area.
・Vertical display position is specified by the rise of ENAB after low level continuation or 4 Hsync period.The data latched at the rise of ENAB is displayed at the top line of the display area.
※ When ENAB alternates between "High" and "Low" level with valid period, "Data enable mode" is available. In this mode, Hsync and Vsync is completely ignored, and ENAB makes display position fit to the display area.

*2) ・When ENAB signal stays "Low" or "High" level, the data latched at the 149 (Thp+Thb+1)-th falling edge of DCLK after falling of Hsync is fixedly displayed at the left edge of the display area for horizontal direction.
・For vertical direction, the data latched in the 36(Tvp+Tvb+1)-th "High" level period of Hsync after falling of Vsync is displayed at the top line of the of the display area.

*3) ・If the "High" level period of ENAB is less than 512 DCLK or the number of ENAB in a frame period(Tv) is less than 768, black color is displayed at the rest of the display area.

*4) ・If ENAB does not synchronize with the effective display data, the display position does not fit to the display area.

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99/04/05	04			Specified ④Spec.
98/11/27	03			③Add and Change.

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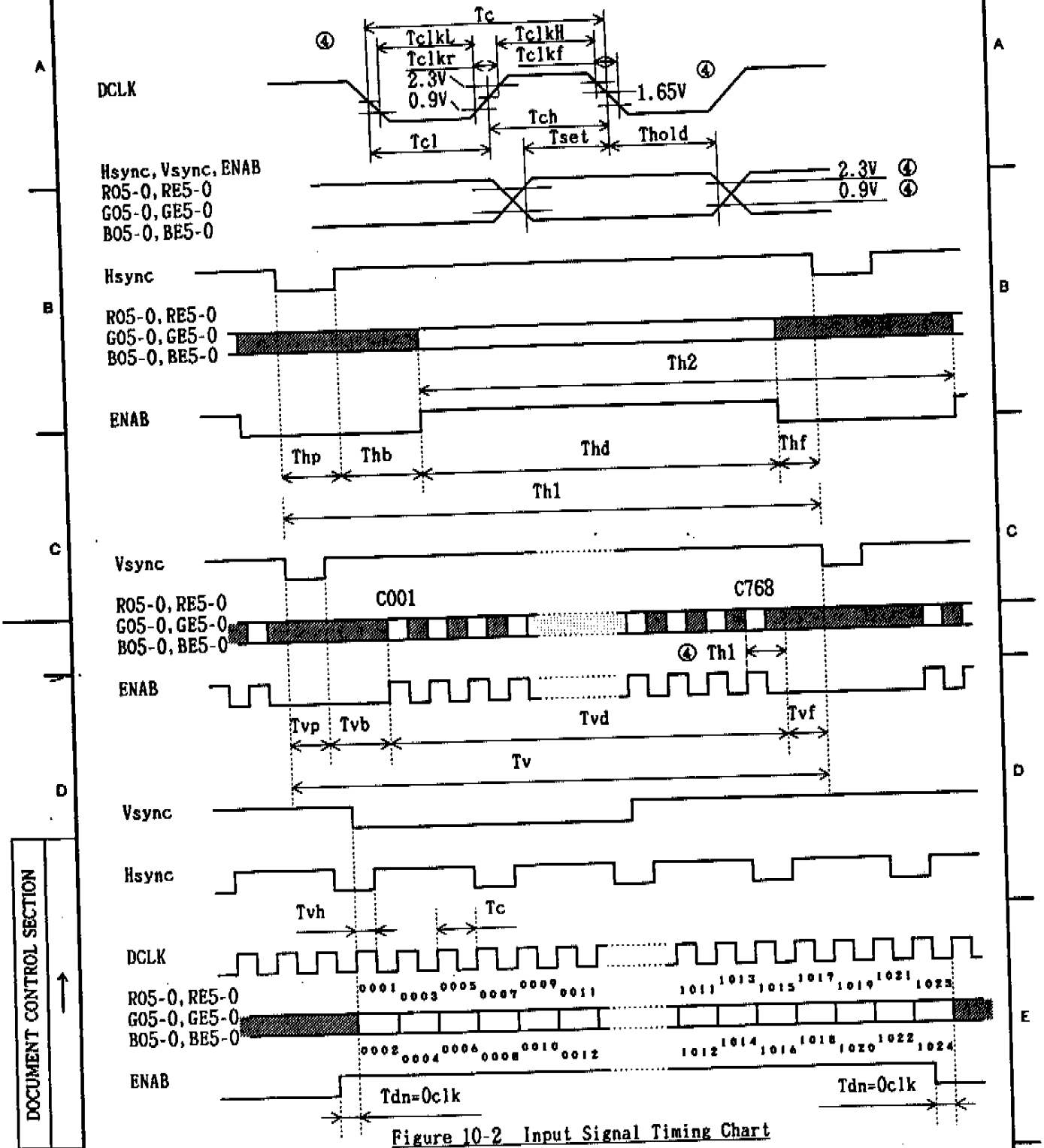

Figure 10-2 Input Signal Timing Chart

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10-4 Correspondence between Data and Display Position

Figure 10-3 shows the Correspondence between Data and Display Position.

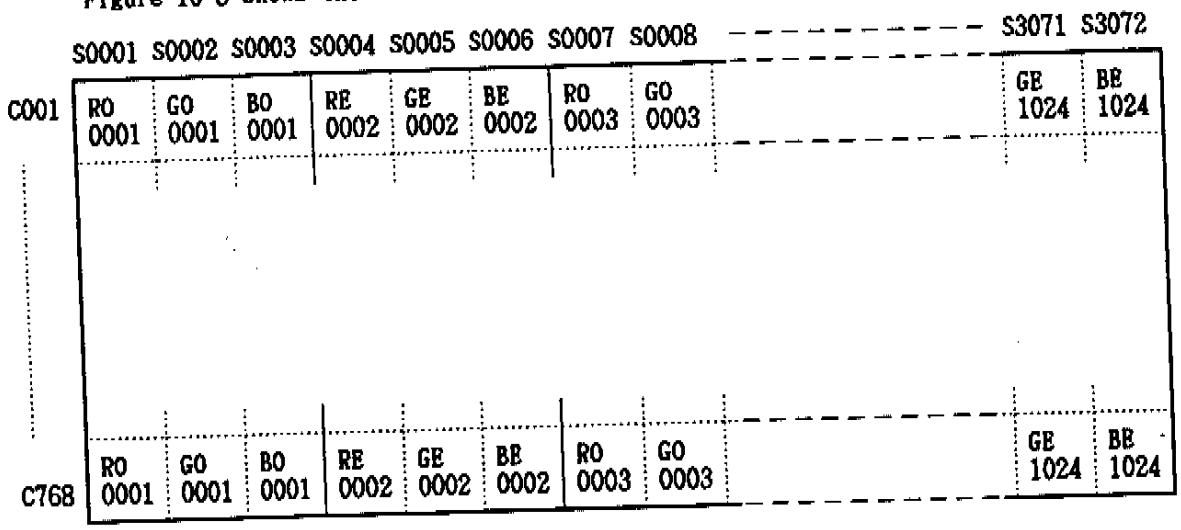

Figure 10-3 Correspondence Data and Display Position

10-5 Power Supply Sequence

The sequence of input signals and On/Off of the power supply of this LCD modul should be in the specification shown in Figure 10-4 to prevent Latch-up of the driver ICs and DC driving of the LCD panel.

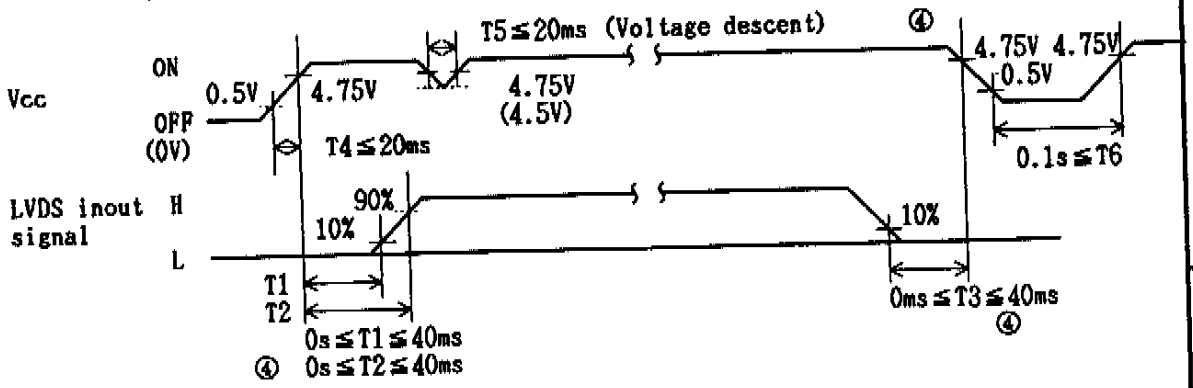

Figure 10-4 Power Supply Sequence

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11. BACK-LIGHT SPECIFICATIONS

11-1 Pin configuration for Back-light

Table 11-1 and 11-2 show the description and Pin assignment of the connectors (CN-A and B) for the backlight of this LCD module.

Table 11-1 Pin Assignment of CN-A

Pin No.	Signal	Function
1	GND	Ground (for V_L 1,2)
2	NC	—
3	NC	—
4	NC	—
5	V_L1	Power supply for CCFL1
6	NC	—
7	V_L2	Power supply for CCFL2

Table 11-2 Pin Assignment of CN-B

Pin No.	Signal	Function
1	GND	Ground (for V_L 3,4)
2	NC	—
3	NC	—
4	NC	—
5	V_L1	Power supply for CCFL3
6	NC	—
7	V_L2	Power supply for CCFL4

Cable color(CN-A and B): White at GND, Pink at V_L1,2,3 and 4

Connector: Housing : XHP-7
Contact : SXH-002T-P0.6
User's Connector : Post with base : B7B-XH-A (Top type) or S7B-XH-A (Side type)
Supplier: Japan Solderless Terminal Trading Company LTD. (=J.S.T.)

11-2 CCFL

Supplier: KOWA ELECTRIC CO.,LTD ② Part No.3301-154-0

11-3 Life

The life of the back-light is a minimum of 25,000 hours at the following conditions.

(1) Working conditions
① Ambient temperature : 25± 5 ℃
② Tube current (I_L) : (7 mA or less)

(2) Definition of life
① Brightness becomes 50% or less than the minimum brightness value shown in Table 9-1.
② The lamp cannot be lit by the minimum value of the breakdown voltage (1500 Vrms) shown in Table 8-1.
③ Flashing

④ 11-4 Lamp Assembly set (for replacement)

Lamp Assembly set (with charge) is prepared for replacing old lamp to new one. This set consists of a upper lamp assembly and a lower lamp assembly.

Type number: FLCL-13S (for upper and lower)

Notes) Type number of a upper lamp assembly is FLCL-10.
Type number of a lower lamp assembly is FLCL-11.

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04 990405			④Add Specified Part No. -	
02 981028				

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12. APPEARANCE SPECIFICATIONS

Length: L [mm]
Width: W [mm]
Average diameter: D [mm]

12-1 Appearance

No.	Item		Judgement method and standard	Remarks
1	Foreign Particle	Black particle	0.5>D N≦4	Recognized in the cell with lighting
		fiber	3.0>L N≦4	
2	Scratch	Scratch on polarizer film	10.0>L N≦6	
3	Nick	Nick on polarizer film	0.5>D N≦6	

Note

- Foreign particle and scratch that do not affect display image, such as foreign particle between glass and polarizer film out of the display area, scratch on metal vessel, back-light module or polarizer film out of the display area, etc. are not counted.
- These items apply to defects in the cell when the backlight is on, and defects on the surface of polarizer film inside the display area.
- Visually inspect appearance with keeping your eyes 35cm or more from the panel, using one 20W fluorescent light illumination at 50cm above the work table. At this time, the illuminance in the vertical direction to the fluorescent light is 400 to 600 lux(reference value).

12-2 Dot defects (Bright spots, Dark spots)

12-2-1 Zone

Inside display dot area (304.1 x 228.1 mm)
Display dot area means active area.
One pixel consists of 3 dots (red, green and blue).

12-2-2 Bright spots

(1) Bright spots classification (based on brightness samples)

- Visible with 2% ND filter --- High Bright spot R・G
- Visible with 5% ND filter but not visible with 2% ND filter --- Low Bright spot R・G・B
- Not visible with 5% ND filter --- not counted

(2) Defects of color filter

- Larger than one half of a dot
- Same or smaller than one half of a dot

(3) Defects of chrome mask

- Larger than φ50μm --- High Bright spot
- Same or smaller than φ50μm --- not counted

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12-2-3 Number of luminescent spot standard

Item	Entire Screen	
Brightness classification	High Bright Spots	High and Low Bright Spots
Number of defects	9 or less	15 or less

NOTES:
1. Display should be all black when luminescent spot is counted.
2. Number of high Bright spots of green(G) is up to 7.
3. Number of two low Bright spot connections is up to 7.
4. Number of three Bright spot connections and two high Bright spot connections is 0.
5. Number of high Bright spot and a low Bright spot connections is up to 4.

12-2-4 Distance between Bright spots

- High Bright spots R and G ------ 15 mm or more
- High Bright spots and low Bright spot ------ 5 mm or more
  (Except one or two of two bright spot connections)

12-2-5 Number of Dark spots standard

Item	Entire Screen
Number of defects	16 or less (When display is all white)

NOTES:
1. Display should be all white when dark spot is counted.
2. Number of two dark spot connections is up to 5.
3. Distance between defects is 5 mm or more.
4. If dark spot is smaller than one dot size, convert with following role and sum up.
   (a) $A < 1/3$: Not count.
   (Only one of 4 dark connection is allowed.)
   (b) $1/3 \leq A < 2/3$: Considered as 0.5 dot.
   (c) $2/3 \leq A$: Considered as 1 dot.
   (A = Dark spot size/dot size)

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13. ENVIRONMENTAL SPECIFICATIONS

Table 13-1 shows the environmental specifications.

Table 13-1 The environmental specifications

Item	Condition		Remark
Temperature	Operation	0～50℃	Temperature on surface of LCD panel (display area).
	Storage	−20～60℃	
Humidity	Operation	20～85%RH	Maximum wet-bulb temperature should not exceed 29℃. No condensation.
	Storage	5～85%RH	
Vibration	Non-operation	10～500Hz, 1 octave / 20 minute, 2G, 1.5mm max, 1 hour each X, Y and Z directions	For single module without package.
Shock	Non-operation	50G, 6ms, 1 times each ② ±X, ±Y and ±Z directions.	

NOTE: Table 13-2 and Figure 13-1 show the shock resistance standard when module is packaged.

Table 13-2 Shock resistance standard when module is packaged

Dropping location	Dropping height	Count
A～J	60cm	1 time

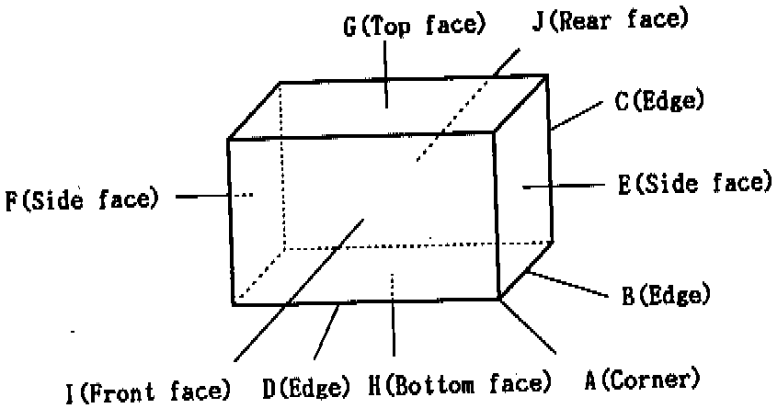

Figure 13-1 Direction to apply shock to package

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02 981028			Shock spec correction.	

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14. INDICATIONS

This module has the following indications. ④

(1) Product name : LCD unit

(2) Model Number : FLC38XGC6V-04

② (3) Product Drawing Number : NA19020-C053

(4) Manufacturing Number : 8 Y 0 0 0 0 1 ②

- 8 — Last digit of manufacturing year
- Y — Manufacturing month (Oct.=X, Nov.=Y, Dec.=Z)
- 0 0 0 0 1 — Serial number (To be reset every month on 1st.)

② (5) Version number : 2 1 H (Example)
- 1st 2 digits "21" means operational version.
- 3rd alphabet means functional version.

(6) Manufacturer Country Name : MADE IN JAPAN

(7) Company Name : FUJITSU LIMITED

(8) Disposal method of cold-cathode tubes. (See Fig.14-1) ④

(9) Caution when chenging cold-cathode tubes. (See Fig. 14-2) ④

Fig. 14-1

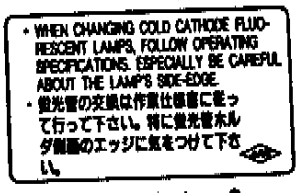

Fig. 14-2

15. PACKAGING

Separately specified in packaging specifications.

15-1 Packing specifications

(1) 5 LCD modules / 1 package.

(2) Weight : approximately 12kg / 1 package.

(3) Outline dimensions : 371 mm(W) × 423 mm(D) × 439 mm(H)

15-2 Packing method

Figure 15-1,2 show the packing method.

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01 '90.04.05			④ Add	
02 '98.10.28			② correction	

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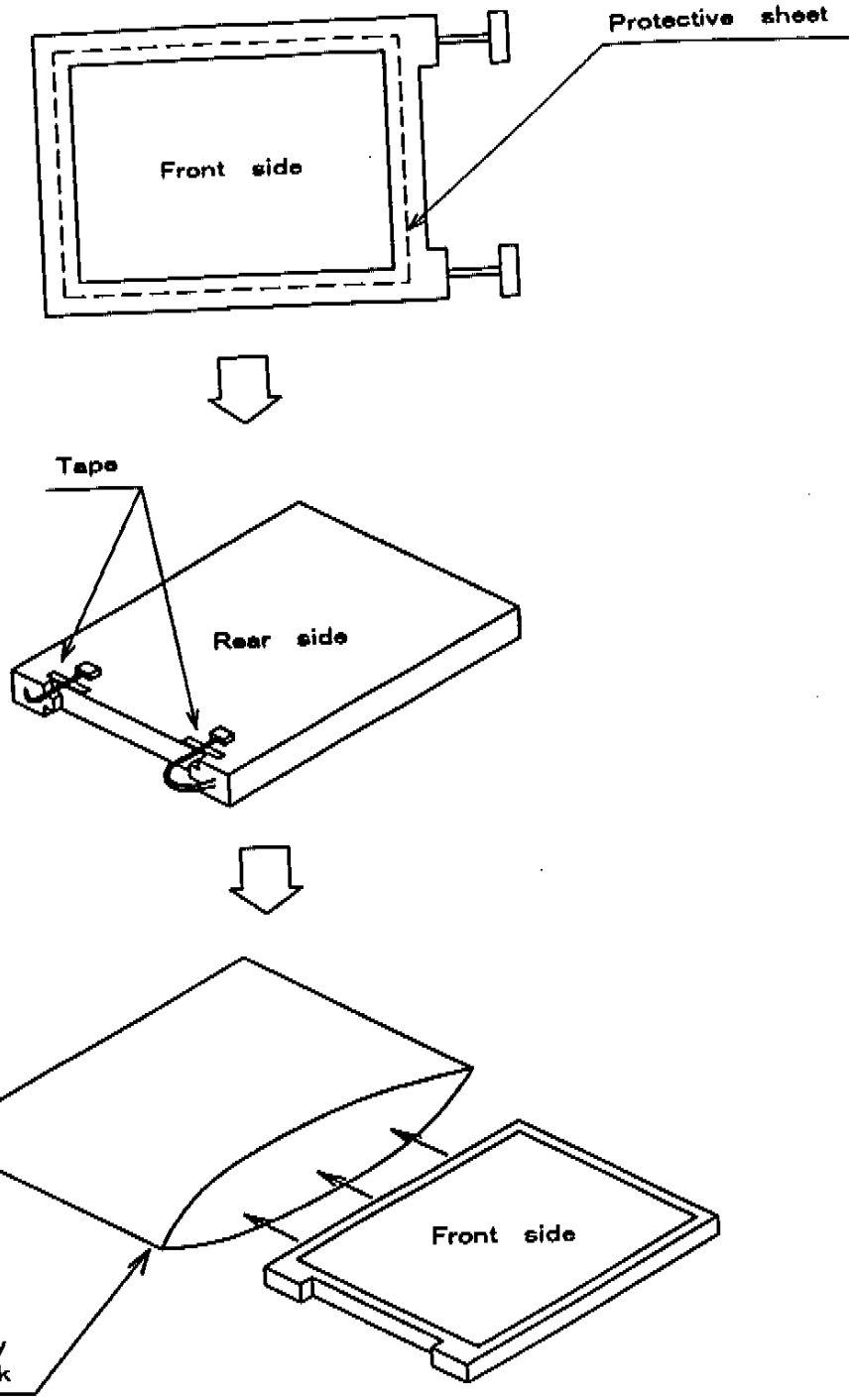

Figure. 15-1 Packing method

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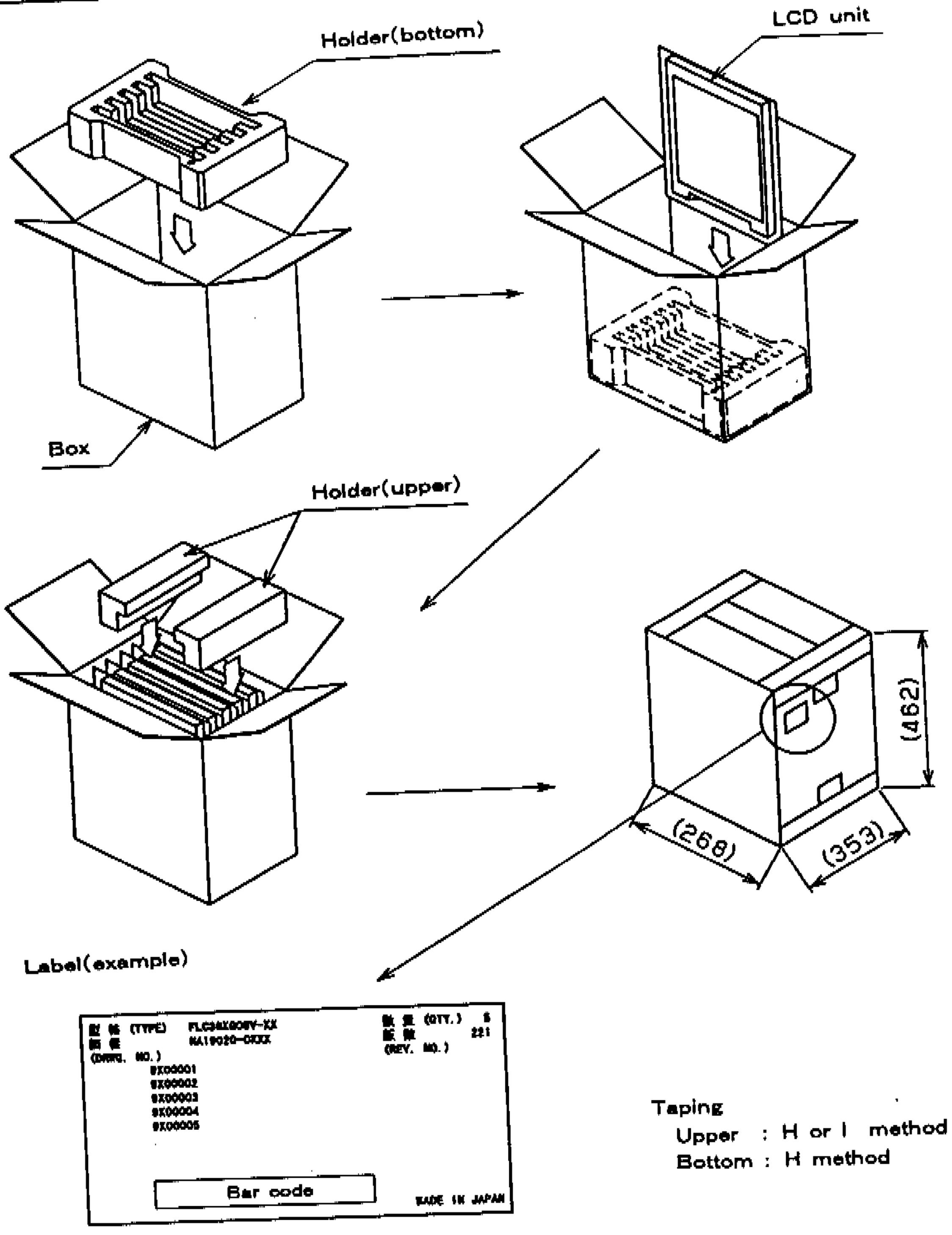

Figure. 15−2 Packing method

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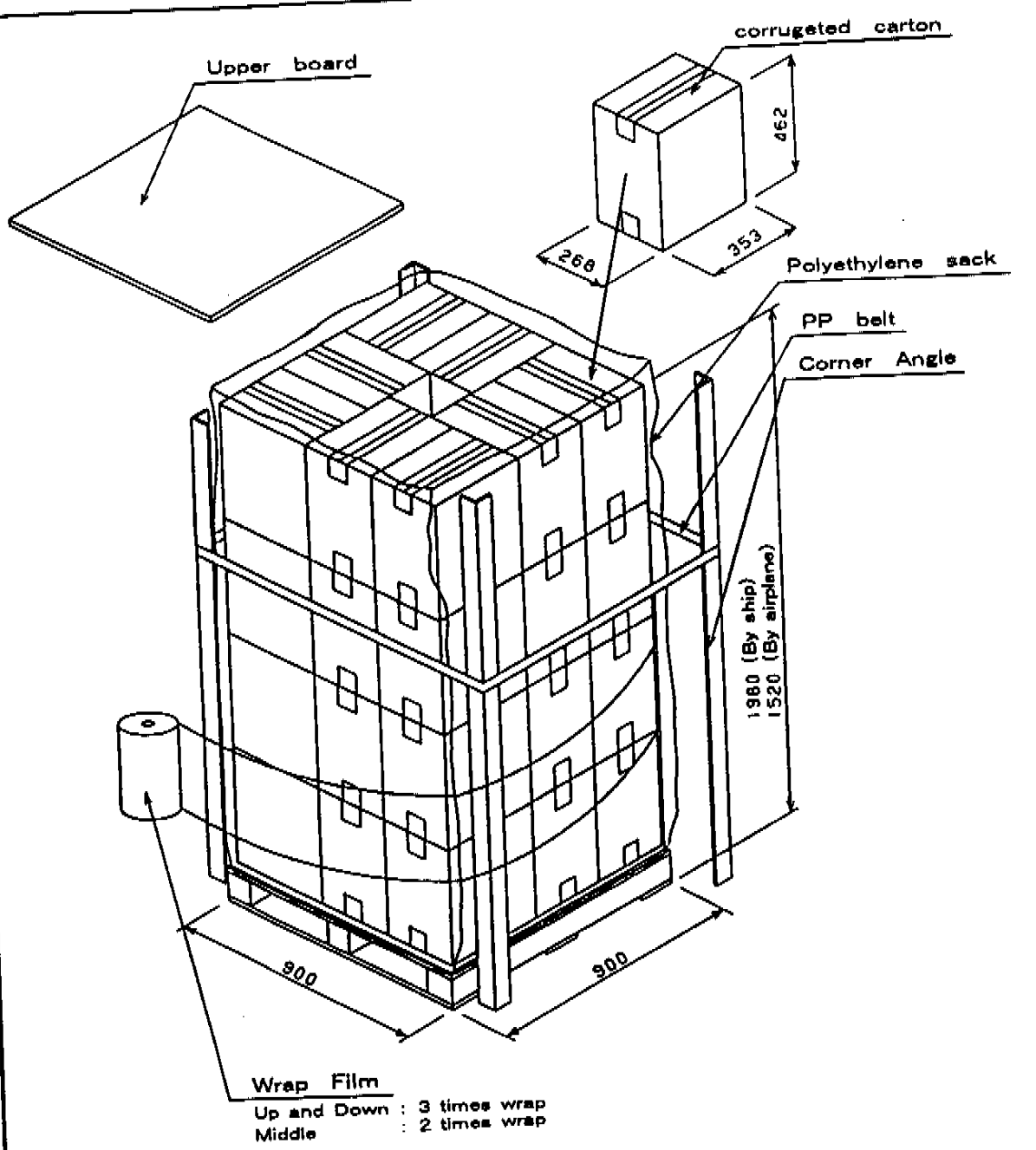

NOTE:
1) 8 boxes × 4 layers(maximum 32 boxes) : by ship
8 boxes × 3 layers(maximum 24 boxes) : by airplane
2) This drawing shows marine transportation specification.

Figure. 15-3 Packing method

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16. WARRANTY

(1) The warranty period is one year after manufacturing. Products which fail during this period are repaired or replaced without charge,unless the failure is caused by user.

17. PRECAUTIONS

Adhere to the following precautions to correctly use this LCD module.

(1) Application

The infomation contained in this document are not intended for use with equipment which requires extremely high reliability such as aerospace equipment, nuclear control systems or medical for life support.

(2) Handling of LCD panel

① **Do not apply any strong mechanical shock to the LCD panel.**
Since the LCD panel is made of glass, excessive shock may damage the panel or cause a malfunction.

② **Do not press hard on the LCD panel surface.**
In the LCD panel, the gap between two glass plates is kept perfectly even to maintain display characteristics and reliability. If this panel is subject to hard pressing, the following occurs.
① Ununiform color
② Orientation of liquid crystal becomes disordered
Problem ① returns to normal after a while. Problem ② returns to normal if power is shut off once then turned on again.
However these occurrences should be avoided to insure reliability.

③ **Do not scratch the polarizer film on the LCD panel surface.**
- Do not press or rub the display surface with a hard tool, pincet, etc.
- For handling, use cotton or conductive gloves so that the display surface is not contaminated.
- If the display surface is contaminated by dust or dirt, clean it as follows with a soft cloth(deer skin, etc.)

(Dust) Wipe off with a soft cloth.(do not rub).

(Dirt) Lightly wipe off with a soft cloth soaked in the specified solvent.
Specified solvent is Isopropyl alcohol.
Do not use water and such solvents as ketone(acetone, etc.) and aromatics (xylene,toluene,etc.)

(Caution) Be careful not to allow the specified solvent to enter the module.
- If saliva or water drops are left for a long period of time, the area may become deformed or discolored.
Wipe off immediately in the same way as for dirt.
- Do not allow oil to adhere to the module, since the cleaning of oil is difficult.

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④ **Do not place or contact objects on the display surface for a long period of time.**
That's because this may made some parts of the LCD module distorted and the display quality may decline.

(3) Handling of LCD module

① **Do not pull the cold-cathode tube cable strongly.**
If the cable is pulled with a 2 kg or stronger force, the cable may be damaged or reliability may decrease.

② **Assemble the module into user's system in a dust free environment.**
If conductive foreign matter adheres to the module, failures may occur.

③ **Take anti-static measures for assembling the module.**
Since the LCD module uses a CMOS-IC, the following consideration are necessary.

- For assembling the module, operator should be grounded and wear cotton or conductive gloves.
- For the area to assemble the device, place an earth mat on the floor and work table, and discharge static electricity via an earth wire.
- If necessary, ground operation tools(soldering iron, radio pliers, pincet, etc.)

- Do not take the module out of the conductive bag until the time when the module is assembled.
- Assemble the module in a humidity controlled environment (50~60%). Do not work in an environment where humidity is extremely low(50% RH or less).

④ **Do not strongly pull the connecting cable on the rear face of the LCD module.**

⑤ **Do not disassemble or remodel the LCD module.**
If this LCD module is disassembled or remodeled, it may have some trouble, or the display quality and reliability may not be assured.

(4) Precautions for operating the LCD module

① **Adhere to the specified power supply sequence.**
If not followed, the CMOS-IC may cause a latchup, or the DC voltage may be appliedo the liquid crystal, and a failure or serious display quality deterioration may occur.

② **Do not operate the LCD module when condensation is present.**
If the LCD module is operated when condensation is present on the output terminals of the LCD panel, the terminals cause electro-chemical reaction, which may cause a disconnection. Condensation easily occurs especailly when the module is moved from a cold environment to a warm environment.

③ **Trouble that occurs when the LCD module is used at not recommended temperature.**

- Operation at high temperature (>50°C) : Display colors shift to blue.
- Storage at high temperature (>60°C) : The polarizer film deteriorates and contrast decreases.
- Operation at low temperature (< 0°C) : The response speed decreases considerably.
- Storage at low temperature (<-20°C) : The liquid crystal may solidify and become damaged.

DOCUMENT CONTROL SECTION

DATE	DESIG.	CHECK	DESCRIPTION	APPR.

TITLE FLC38XGC6V-04
DRAW. NO. Tech Bes 98/27972
CUST.
FUJITSU LIMITED
SHEET 26 /
89.8 FDXA-4902-6

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④ Always input the control signals at the correct timing.
If control signals(DCLK, ENAB or DCLK, Hsync,Vsync) are not input, or if the timing is out of the specified timing, ~~the internal circuit automatically generates signals and displays a specified pattern to protect the liquid crystal panel.~~
~~However, in this status the display does not satisfy the desired display quality.~~
④ Liquid crystal maight be damaged such as memorizing image or contrast decreases by influence of direct current driving.

(5) Precautions on designing module mounting

① Do not press the display surface and bottom face of the LCD module.
If the display surface is very strongly pressed due to the module mounting design, the desired display quality and reliability may not be assured.
If the back-light base is pressed due to the module mounting design, brightness uniformity and the reliability of the cold-cathode tube may not be assured.

② Consider the module mounting design, so that twisting and bending do not occur to the LCD module.
Outstanding twisting and bending may damage display quality and reliability.

③ The power cable length between the LCD module and inverter should not be extended.
Otherwise the back-light may not light or flickering may occur.

④ Do not make the power cable of the backlight clung to a metal plate, etc.
High frequency current for the back-light may leak to the metal plate, and the desired brightness may not be assured.

⑤ When Mounting LCD module with M4 screw (x4) should be screw up under 4.5kgf torque.

(6) Storage method

① Do not store the LCD module in an atmosphere of organic solvent or corrosive gas.
In an organic solvent atmosphere, the polariser film discolors and display quality deteriorates. In a corrosive gas environment, various problems may occur.

② Store the LCD module in a Fujitsu package.
At storing, Fujitsu packages can be stacked to a maximum of 4.
The LCD module is in an anti-static bag. Keep the module in that status.

③ It is recommended that the storage environment should be humidity controlled, cool and dark.

Recommended storage environment
- Place : Dark(avoid direct sunlight)
- Temperature : 10~35℃
- Humidity : 50~60%RH

Note) If the module is left in an environment of 60 ℃ or more for a long period of time, optical characteristics may deteriorate.

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18. OTHERS

! ① **If the LCD panel is damaged, do not inhale or allow the liquid crystal to enter the mouth**
If the liquid crystal contacts the body or cloth, immediately wash it off with soap. Follow precautions for regular electronic components.

② **It is no problem that solder flux can remains on a printed circuit boad of the LCD module**
Fujitsu is practicing a non-wash technology for the module assembly process.

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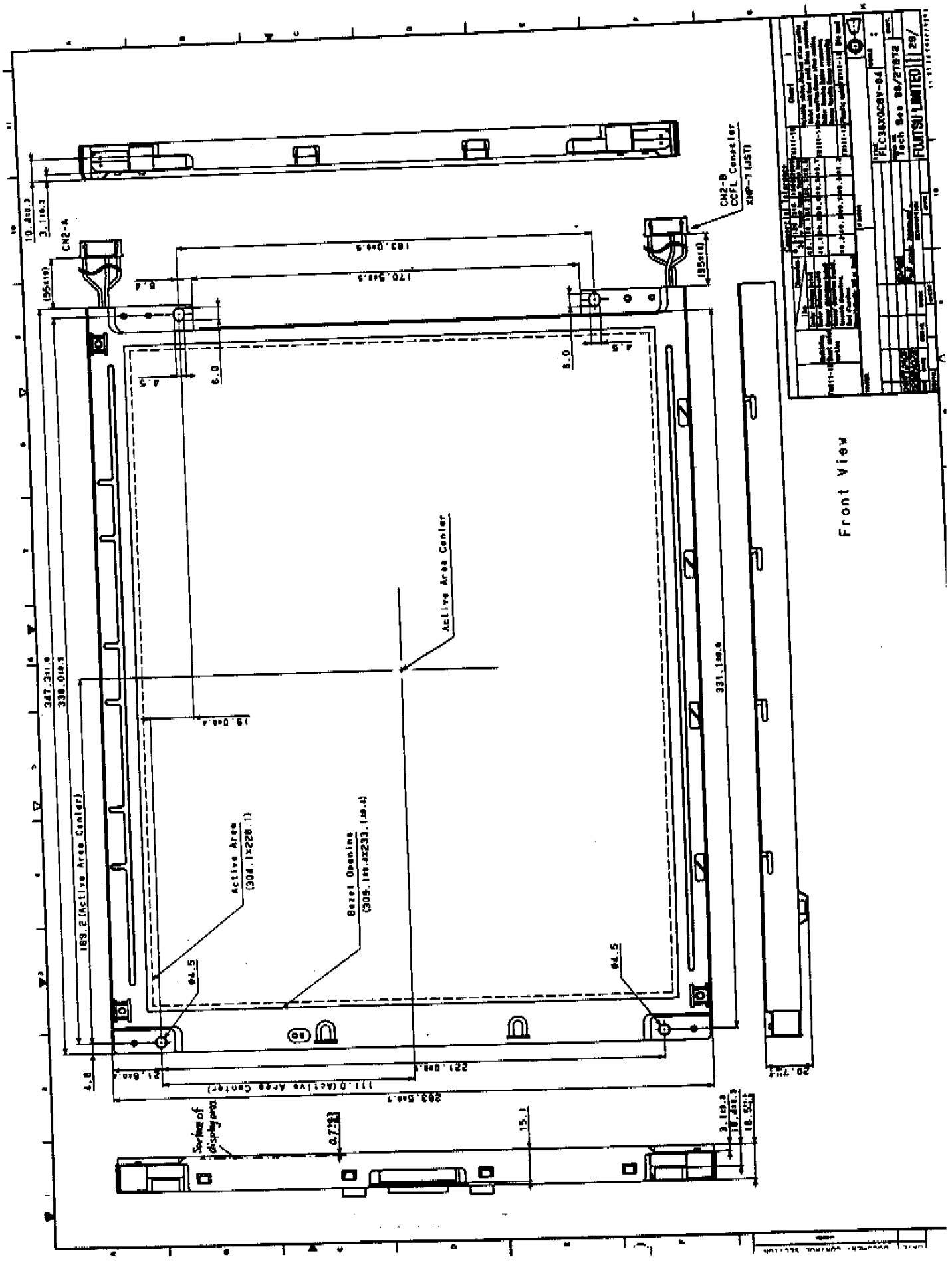

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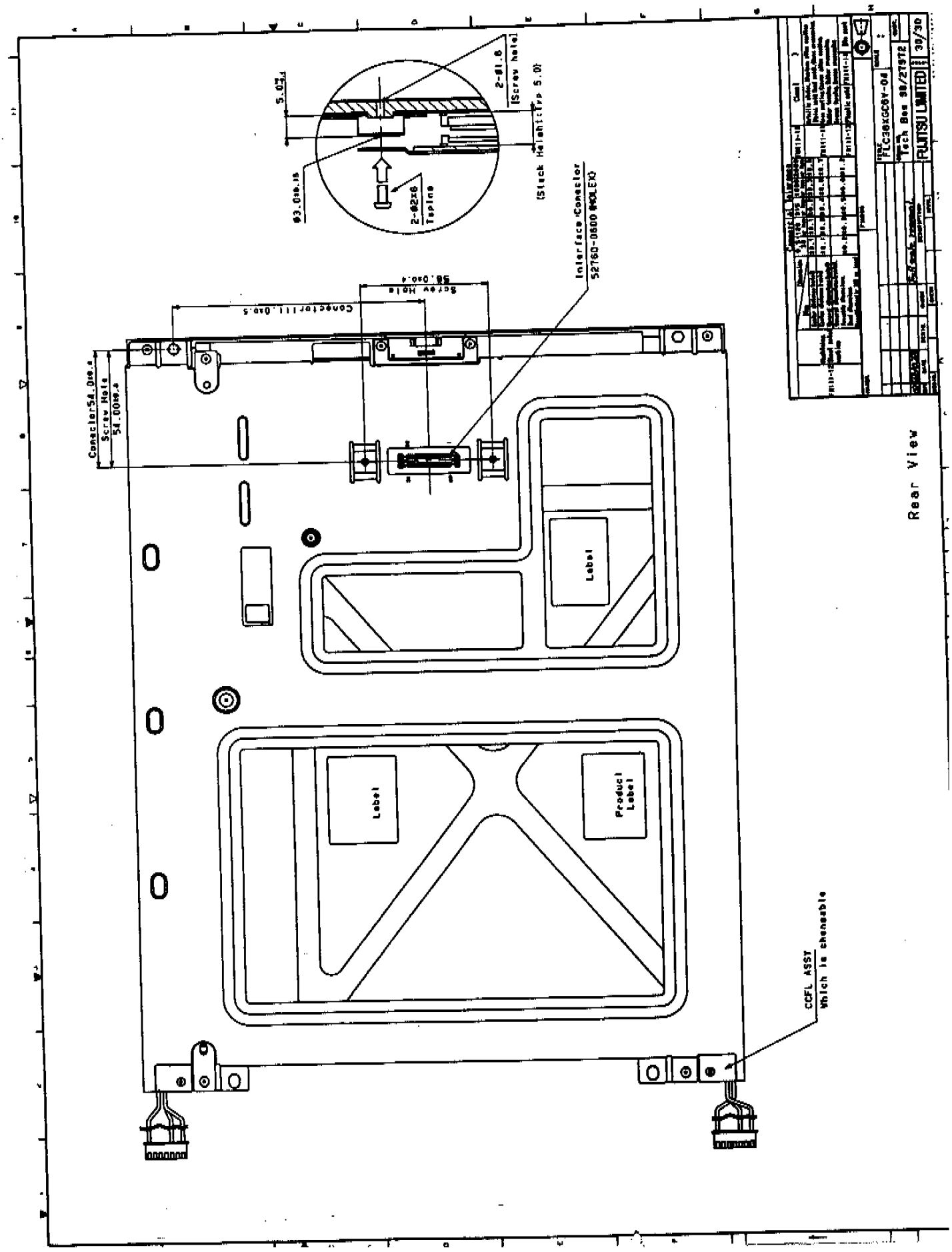

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