LCD MODULE

SPECIFICATION

Products Name:APAX T1504
38.0CM(15.0 INCH)XGA(1024x768)
COLOR TFT LCD MODULE

5.0V

● **Preliminary Specification**
  This technical specification is tentative and it will be changed without notice.

REVISION HISTORY

Revision	Date	Prepared	Checked		Approved	Summary
01A	Aug. 14, 2000	Miyahara		Fukuhara	Naka	1st issue

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DESIG.	20000811	Miyahara	CHECK			APPR.	Fukuhara	

FLC38XGC6V-06

Tech Bes LCD-00033

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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 Name : FLC38XGC6V-06

3. OVERVIEW

This LCD module has a TFT active matrix type liquid crystal panel 1024×768 pixels, and diagonal size of 38cm (15.0-inch). This module supports 1024×768 XGA mode (Non-interlace).

This LCD has a digital RGB interface and can display 262,144 colors.

Timing control signal is "Data enable signal : ENAB" only. (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 ×2) 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 LCD panel, LCD driving circuit, control circuit, interface circuit and backlight unit.

The LCD panel is active matrix TFT type and Fujitsu's unique MVA (Multi-domain Vertical Alignment) liquid crystal technology is adopted in it. The LCD driving circuit is integrated in IC chips, which are bonded on plastic wiring film (hereinafter TAB driver-IC), and the output terminals of the IC chips are connected to the LCD panel. The control circuit and the interface circuit are mounted on three kinds of printed circuit board (hereinafter PCB) and the input of the TAB driver-ICs are connected to the PCBs.

With such circuit construction, the image data received by the interface circuit is forwarded to the control circuit and the control circuit modulates the image data to LCD driving signals. The TAB driver ICs buffer the LCD driving signals and output driving voltages to the LCD panel.

These LCD parts such as the LCD panel, the TAB-ICs and the PCBs are assembled together with the backlight module in a plastic case and a metal frame.

Fig.4-1 shows a block diagram of this LCD module.

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Vcc
(+5V) →

DC/DC
Converter →

Data Driver

ENAB →
RO-5 →
GO-5 →
BO-5 →
DCLK →

Interface Circuit → Control Circuit → Gate Driver →

LCD Panel

B

(External)

V_DD → Inverter

Backlight

Fig.4-1.Block Diagram

C

5. MECHANICAL SPECIFICATIONS

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

Table 5-1. Mechanical Specifications

Item	Specifications	Unit	Remark
Dimensions	347.3×263.5×15.8(TYP.) (Excluding I/F Connector and fixing parts)	mm	Edge type backlight is used. (φ2.6 CCFL×4) Outward Appearance is shown at page 30 and 31.
Display Resolution	(1024×3) ×768	—	
Display Dot Area	304.1×228.1	mm	
Dot Pitch	(0.099×3) ×0.297	mm	
Aspect Ratio	1 : 1	—	
Weight	1,500 max	g	
FG-SG	Short circuit	—	

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6. ABSOLUTE MAXIMUM RATINGS

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

Table 6-1. Absolute Maximum Ratings

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

7. RECOMMENDED OPERATING CONDITIONS

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	V_{CC}	V_{RP}	—	—	100	mV

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8. ELECTRICAL SPECIFICATIONS

Table 8-1 shows the electrical specifications of this LCD module.

Table 8-1. Electrical Specifications

	Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark
	Supply Current	I_{CC}	$V_{CC=}+5.0\pm0.25V$ Vss=0V DCLK=32.505MHz	—	380	800	mA	*1
	"H" Level Logic Input Voltage	V_{IH}		2.3	—	V_{CC}	V	
	"L" Level Logic Input Voltage	V_{IL}			—	0.9	V	
	Leak Current (Logic Input)	I_{IL}		-5	—	+5	μA	
	Supply Rush Current	I_{SCC}		—	—	5.5	A	*2
	Supply Rush Current Duration (1A excess)	T_{SCC}		—	—	0.4	ms	
	Contrast Regulation VR	R_{VR}		0	—	100	kΩ	
BACK LIGHT *4	CCFL Turn on Voltage		=50kHz, Ta=25ºC	—	1324	1500	Vrms	
			=50kHz, Ta=0ºC	—	1324	1500		
	Lighting Voltage		=50kHz =7mA	550	580	610	Vrms	
	Lighting Frequency		=580Vrms	40	50	60	kHz	
	Tube Current		=50kHz V =580Vrms	6	7	8	A	*4

(*1) Typical current value is measured when color bar pattern is displayed at Vcc=5.0V.
Maximum current value is measured when 55/63 and 63/63 gray scale pattern every 2 pixel is displayed at Vcc=4.75V.
Without rush current.

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

(*3) Backlight specifications are valid when using a suitable inverter such as the "FLCV-07" of Fujitsu Limited.

(*4) Tube current (I_L) shows the value of the current that is consumed at one lamp.
This LCD module has 4 lamps. Each 2 lamps are placed at upper and lower side of the display.
2 lamps are connected in parallel. Each low voltage terminals are bound into 1 line cable, which connected to the backlight connector.
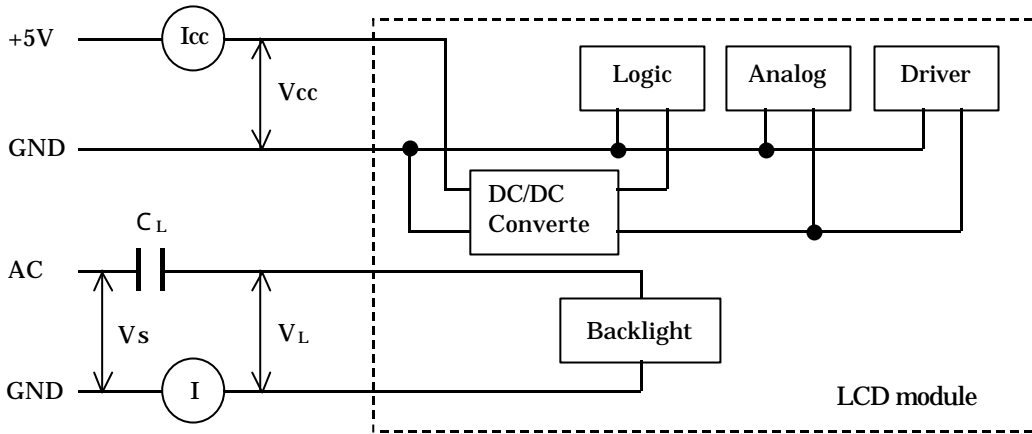
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A

Note 1) Measurement Circuit

Based on Fig.8-1.

+5V ── Icc ─┐

Vcc

GND ──────┤

| Logic | Analog | Driver |

DC/DC Converte

AC ── L ──┤

Vs V_L

GND ── I ──┤

Backlight

LCD module

Fig.8-1. Measurement Circuit

Note 2) Equivalent Circuit

Based on Fig.8-2 (a), (b).

Input signals

DCLK ──○── EMI Filter ──→

CMOS logic signal (Internal)

ENAB ──○──────→
RO0~5,RE0~5
GO0~5,GE0~5
BO0~5,BE0~5

EMI Filter.............MEM2012TC100(TDK)
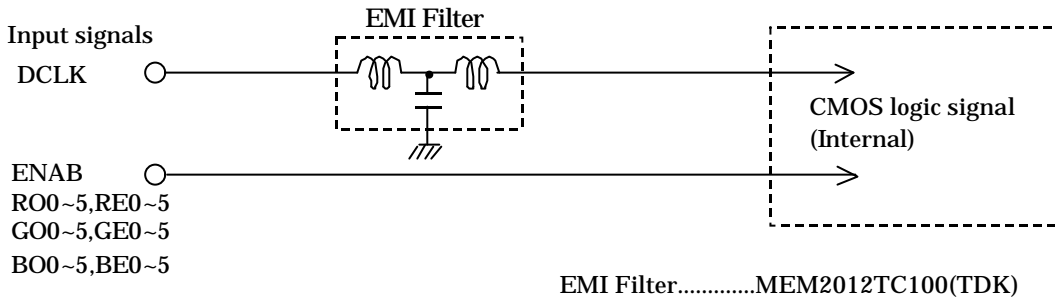
Fig.8-2 (a) Equivalent Circuit of Logic Signal Input

Fuse (2A)   EMI Filter

Vcc ──○──/\/──── EMI Filter ──┬──┬──┬──→ Internal Circuit

10μF 10μF 100pF

GND ──○──┐
FG
Frame ground

Fuse ....KAB2402202NA   (Matsuo Electric CO., LTD.)
EMI Filter............SGM20C1E332-2A(Sumitomo Metals)
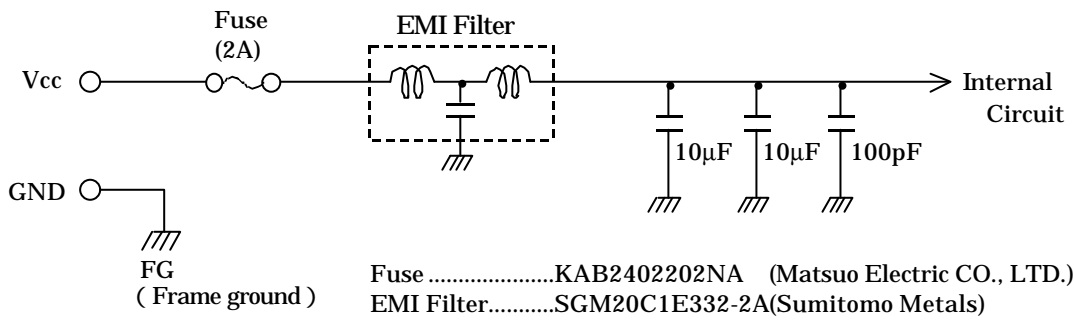
Fig.8-2 (b) Equivalent Circuit of Power Supply

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9. OPTICAL SPECIFICATIONS

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

Table 9-1. Optical Specifications   Ta=25ºC

Item		Symbol	Condition		Specifications			Unit	Remark	
					MIN.	TYP.	MAX.			Note
Visual Angle	Horizontal	$\theta_{L,R}$	CR≥10	$\theta_{U,D}=0^o$	80	—	—	deg		(1)(2)(3)(5)(6)
	Vertical	$\theta_{U,D}$		$\theta_{L,R}=0^o$	80	—	—	deg		
Contrast Ratio		CR	$\theta_{L,R,U,D}=0^o$		210	400	—	—	White/Black	(1)(2)(3)(5)
Response Time(ON) (B→W)		t_{on}	$\theta_{L,R,U,D}=0^o$	Ta=25ºC	—	15	30	ms		(1)(4)(5)
				Ta=0ºC	—	50	100	ms		
Response Time(OFF) (W→B)		t_{off}	$\theta_{L,R,U,D}=0^o$	Ta=25ºC	—	10	25	ms		
				Ta=0ºC	—	50	100	ms		
Brightness		I	$\theta_{L,R,U,D}=0^o$ $V_{CC}=5V$, $I_L=7mA$ (at maximum brightness)		200	250	—	cd/m²	White *1	(1)(5)
Brightness Uniformity		ΔI			80	—	—	%		(1)(5)(7)
Chromaticity	W	X			0.283	0.313	0.343	—		(1)(5)
		Y			0.299	0.329	0.359	—		
	R	(x, y)		Red	(0.600, 0.342) TYP.					
	G			Green	(0.295, 0.571) TYP.					
	B			White	(0.148, 0.112) TYP.					
LCD Panel Type			TFT Color							
Display Mode			Normally 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:25%, 2H)							

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

(Note) •CS-1000 (MINOLTA Co., Ltd.) , BM-5A(Topcon) or equivalent luminance colorimeter should be used for the measurement.
Field=2º, L=500mm
•The specified value of viewing angle, contrast, brightness, brightness uniformity and chromaticity are under the dark room condition (1lux or less).

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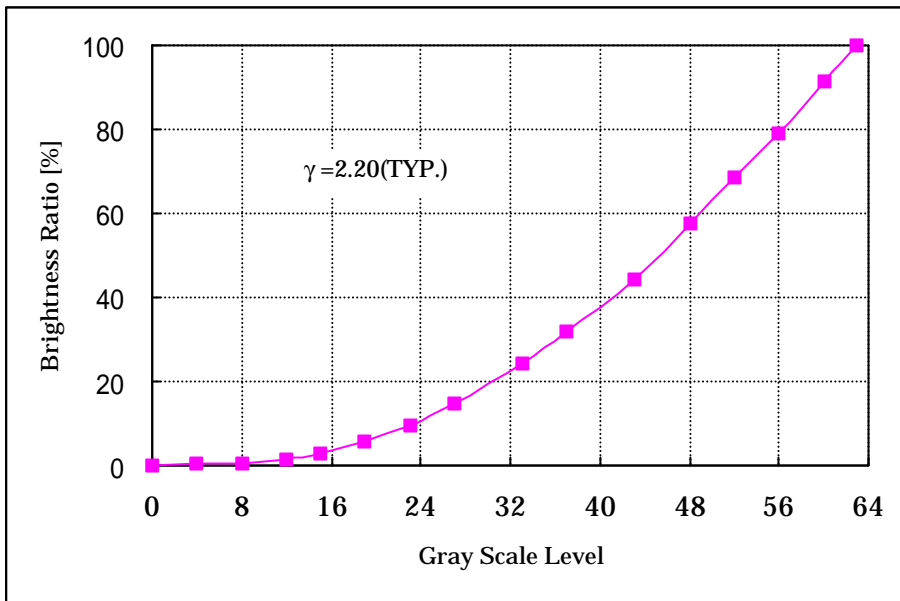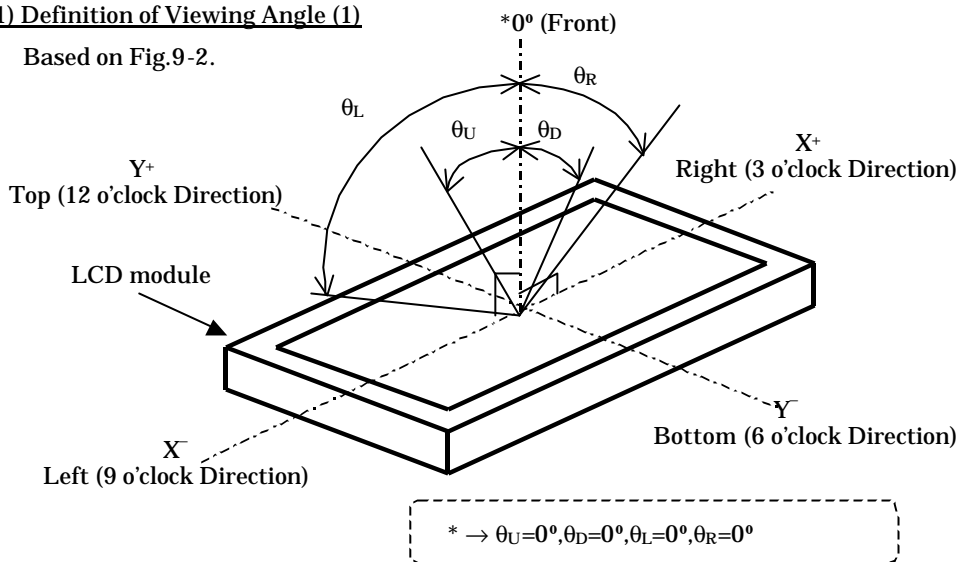EDIT | DATE | DESIG. | CHECK | APPR. | DESCRIPTION
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A

B

C

D

E

F

DATE

Fig.9-1. γ-Curve (Reference Value)

γ =2.20(TYP.)

Brightness Ratio [%]

100

80

60

40

20

0

0   8   16   24   32   40   48   56   64

Gray Scale Level

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Note 1) Definition of Viewing Angle (1)

Based on Fig.9-2.

*0° (Front)

θ_R

θ_L

θ_U θ_D

Y+
Top (12 o'clock Direction)

X+
Right (3 o'clock Direction)

LCD module

Y−
Bottom (6 o'clock Direction)

X−
Left (9 o'clock Direction)

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

Fig.9-2. Definition of Viewing Angle (1)

Note 2) Definition of Viewing Angle (2)

Based on Fig.9-3.

Display Surface

θ_{MAX}
θ_{TYP}
θ_{MIN}

Display Surface

$\theta_{L,R,U,D} = 0°$
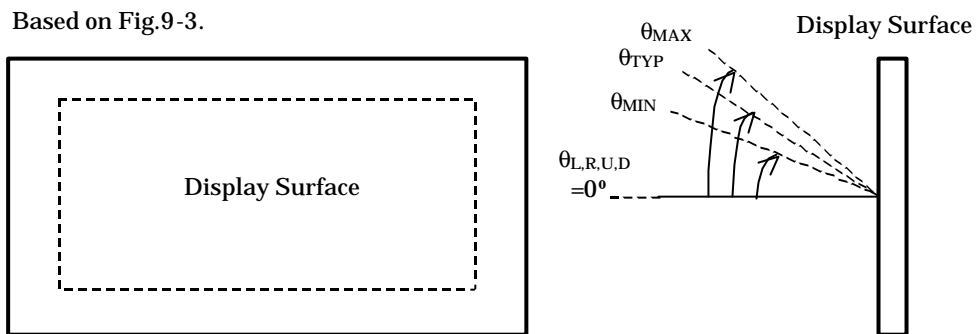
Fig.9-3. Definition of Viewing Angle (2)

Note 3) Definition of Contrast Ratio (CR)

Determined by Formula (1) based on Fig.9-4.Voltage-Brightness Characteristics.

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

White

L

Brightness
L

Black

L

0

0   Panel Drive Voltage [V]
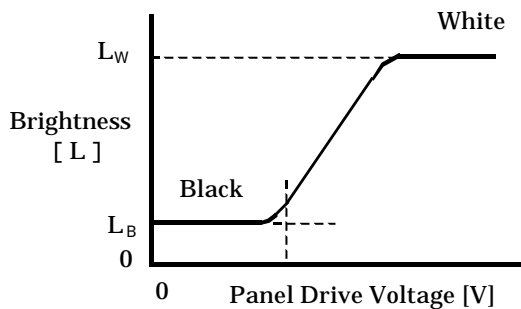
Fig.9-4. Voltage-Brightness Characteristics

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Note 4) Definition of Response Time

Based on Fig.9-5.

Drive signal of LCD panel — ON / OFF

Non-select status ——×—— Select status ——×—— Non-select status

Relative Brightness

100%

90%

White

0%

Black

10%

Black

t_{on}

ON Response Time

t_{off}

OFF Response Time

Fig.9-5. Definition of Response Time

Note 5) Contrast Ratio and Response Measurement System

Based on Fig.9-6.

Y^+ X^+ Z^- Z^+ X^- Y^- θ

Brightness Meter or Luminance Colorimeter (with luminosity correction function)

Drive and Measurement System

Fig.9-6. Contrast Ratio and Response Time Measurement System

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Note 6) Definition of Optimum Viewing Angle

Based on Fig.9-7.

MAX

Contrast
Ratio

10

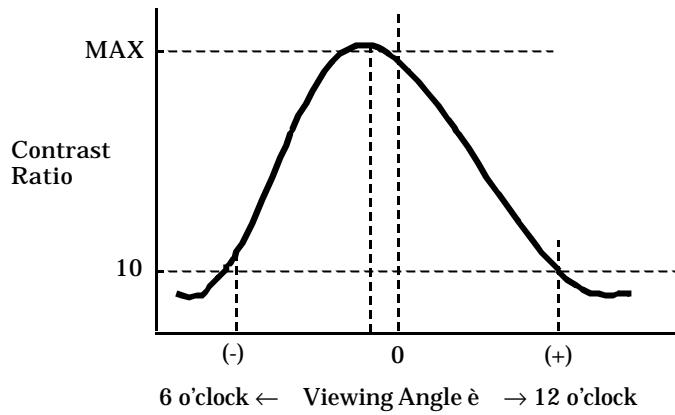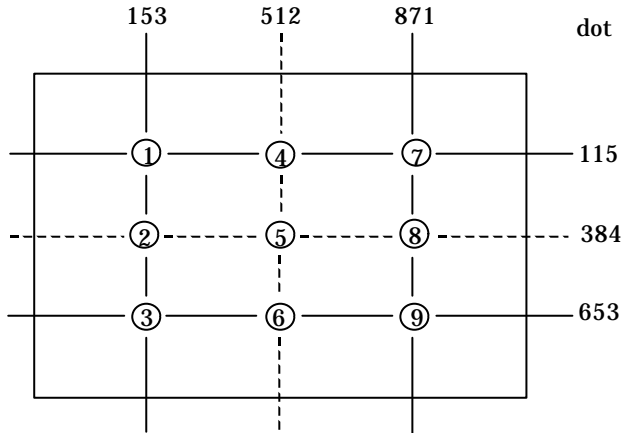(-)　　　　0　　　　(+)

6 o'clock ← 　Viewing Angle è 　→ 12 o'clock

Fig.9-7. Definition of Viewing Angle

Note 7) Definition of Brightness Uniformity

Brightness uniformity is defined by the following formula.
Brightness (I1~I9) art measured at the following 9 points (①~⑨) on the display area shown in Fig.9-8.

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

153　　　　512　　　　871　　　　dot

①　　　④　　　⑦　　　115

②　　　⑤　　　⑧　　　384

③　　　⑥　　　⑨　　　653

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

Fig.9-8. Measurement Points

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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 (CN1)

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	PULL	I	(*2)
15	GND	—	Ground	45	PULL	I	(*2)
16	BE0	I	Blue even data 0	46	ENAB	I	Data 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	SS	—	SS function ON/OFF (*1)
23	RO0	I	Red odd data 0	53	N.C.	—	—
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

(*1) SS (Spread Spectrum):SS function is ON when signal level is high or N.C..(generally set up N.C.)

SS function is OFF when signal level is low.

(*2).Connect it to GND for the protection of internal circuit.

Upper side

Interface connector

LCD Module
Rear side

31 ⎡ 30
60 ⎣ 1

Lower side
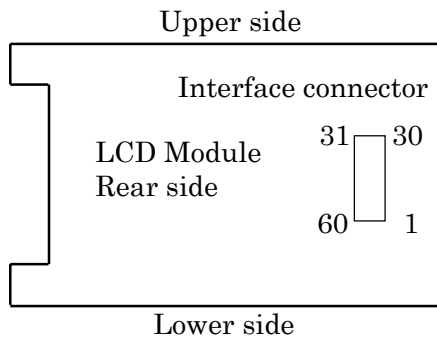
Connector : 52760-0600 (Molex)

User's connector : 53475-0600 (Molex)

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10-2. Color Data Assignment

Table 10-2 shows the color data assignment.

Table 10-2. Color Data Assignment

Color		Odd / Even	R Input data						G Input data						B Input data					
			R05 / RE5	R04 / RE4	R03 / RE3	R02 / RE2	R01 / RE1	R00 / RE0	G05 / GE5	G04 / GE4	G03 / GE3	G02 / GE2	G01 / GE1	R00 / GE0	B05 / BE5	B04 / BE4	B03 / BE3	B02 / BE2	B01 / BE1	B00 / 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	1	1	1	1	1	1
	White		1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
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	0	1	0	0	0	0	0	0
	⇩	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	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.

　　　　　　　　　　The gray scale is brighter as the number is larger.

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

Note.3) Color data consist of 36 bits, namely, 6-bit odd and even data for each red, green and blue.
Optional data can be set to red, green and blue independently.
Therefore, the module is able to display 262,144 colors.

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10-3. Input Signal Timing

Table 10-3 and Fig.10-3 shows the input signal timing.

<u>Table 10-3. Timing Characteristics</u>   (T=0~50ºC, Vcc=5±0.25V)

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK signal (Clock)	Period	Tc	25.000	30.764	40.000	ns	
	Frequency	fc	25.000	32.505	40.000	MHz	fc=1/Tc
	Duty	Tch/Tc	45	50	55	%	*1
	High time	TclkH	5.0	—	—	ns	
	Low time	TclkL	5.0	—	—	ns	
	Rise time	Tclkr	—	—	5.0	ns	
	Fall time	Tclkf	—	—	5.0	ns	
DCLK-Data Timing	Setup time	Tset	4.5	—	—	ns	40MHz
	Hold time	Thold	6.5	—	—	ns	40MHz
Data-ENAB timing / Horizontal	Period	Th	565	672	1566	DCLK	fh=1/Th
	Frequency	fh	38.6	48	60	kHz	
	Display period	Thd	—	512	—	DCLK	*2,3
Vertical	Period	Tv	772	806	868	Th	16.67ms
	Frequency	fv	50	60	75	Hz	
	Display period	Tvd	—	768	—	Th	*2,3
Data-ENAB timing		—	—	0	—	DCLK	*4

*1) DCLK signal input must be valid while power supply is applied.

*2) Display position is specified by the ENAB signal.
· Horizontal display position is specified by the rise of ENAB signal. The data of a horizontal line, which is latched by the falling edge of 1st DCLK right after the rise of ENAB, is displayed on the left edge of the screen.
· Vertical display position is specified by the rise of ENAB after a "Low" level period equivalent to eight times of horizontal period. The 1st data corresponding to one horizontal line after the rise of ENAB is displayed at the top line of screen.

*3) If a period of ENAB "High" is less than 512 DCLK or less than 768 lines, the rest of the screen displays black.

*4) The display position does not fit to the screen if the ENAB period and the effective data period do not synchronize with each other.

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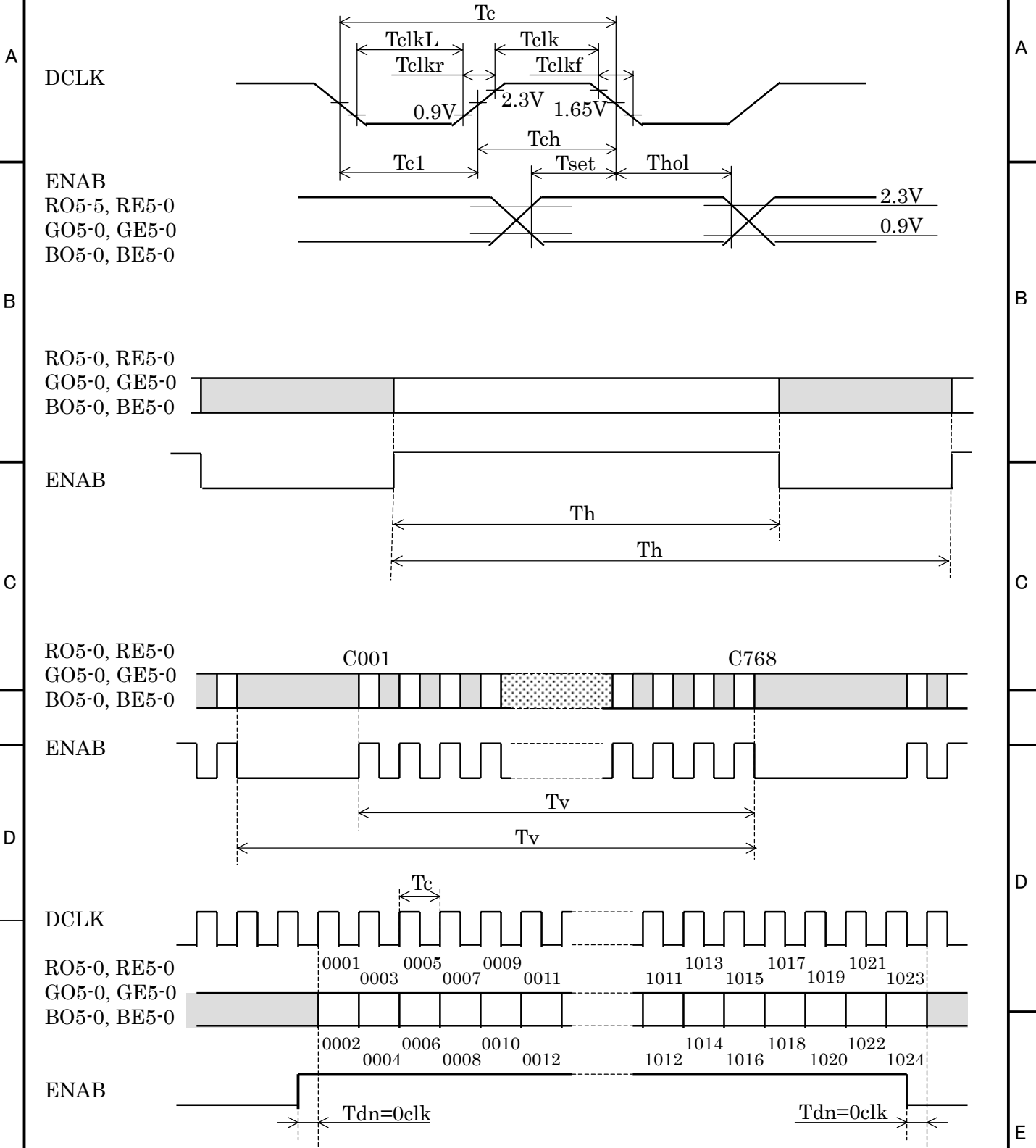
Fig.10-3.Input Signal Timing Chart

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10-4. Correspondence between Data and Display Position

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

S0001 S0002 S0003 S0004 S0005 S0006 S0007 S0008 ···························· S3071 S3072

C001	RO 0001	GO 0001	BO 0001	RE 0002	GE 0002	BE 0002	RO 0003	GO 0003	GE 1024	BE 1024
C768	RO 0001	GO 0001	BO 0001	RE 0002	GE 0002	BE 0002	RO 0003	GO 0003	GE 1024	BE 1024

Fig.10-4.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 module should be in the specification shown in Fig.10-4 to prevent latch-up of the driver ICs and DC driving of the LCD panel.

$T5 \leq 20ms$(Voltage descent)

Vcc ON / OFF (0V)
4.75V
4.75V (4.5V)
4.75V 4.75V
0.5V
$T4 \leq 20ms$
$0.1s \leq T6$

Input signal H / L
90%
10%
10%
T1
T2
$0ms \leq T3 \leq 40ms$
$10ms \leq T1 \leq 40ms$
$10ms \leq T2 \leq 40ms$
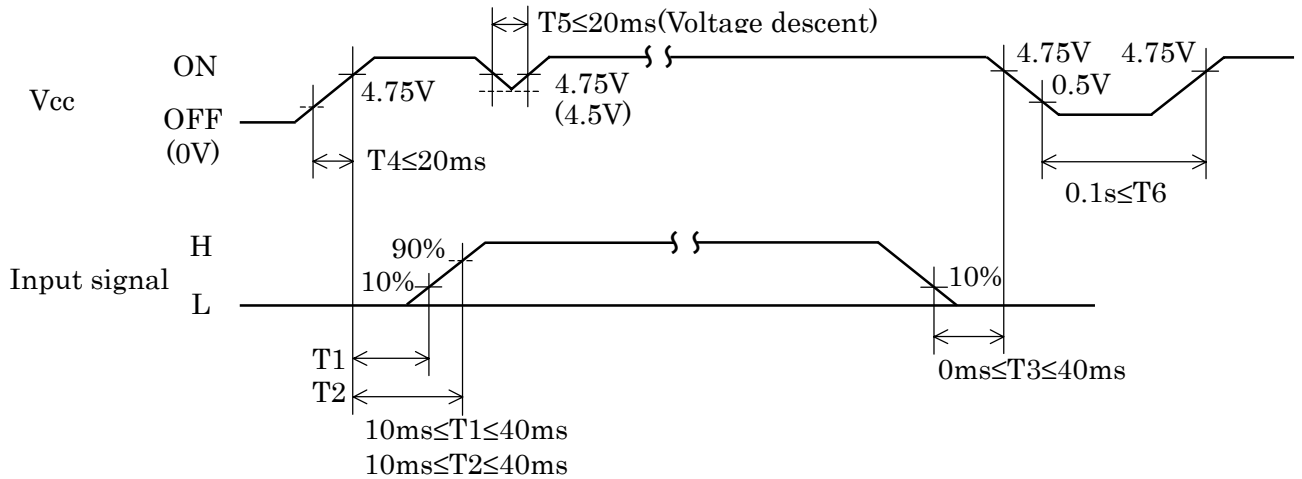
Fig.10-5. Power Supply Sequence

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11. BACKLIGHT SPECIFICATIONS

11-1. Pin Configuration for Backlight

Table 11-1(a) and 11-1(b) shows the description and pin assignment of the connectors (CN-A and B) for the Backlight of this LCD module.

Table 11-1(a) Pin Assignment of CN-A

Pin	Signal	Function
1	V_L1	Power supply for CCFL 1
2	V_L2	Power supply for CCFL 2
3	NC	
4	GND	Ground (for $V_L1, 2$)

Table 11-1(b) Pin Assignment of CN-B

Pin	Signal	Function
1	V_L3	Power supply for CCFL 3
2	V_L4	Power supply for CCFL 4
3	NC	
4	GND	Ground (for $V_L3, 4$)

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

Connector   : Housing   : BHR-04VS-1
         : Contact   : SBH-001T-P0.5
User's Connector : Post with base : SM04(4.0)B-BHS-1-TB
Supplier   : Japan Solderless Terminal Trading Company LTD. (J.S.T.)

11-2. CCFL

Supplier : SANKEN ELECTRIC CO., LTD Part No. KFN8319F315296Z

11-3. Life

The life of the backlight is a minimum of 50,000 hours at the following conditions.

(1) Working conditions
  Ambient temperature : $25\pm5ºC$
  Tube current(I_L)   : (7mA or less)

(2) Definition of life
  Brightness becomes 50% or below 50% of the minimum brightness value shown in Table 9-1.
  The lamp cannot be lit by the breakdown voltage of 1500Vvms.
  Lamp is flashing.

11-4. Lamp Assembly set (for replacement)

Lamp Assembly set (with charge) is prepared for maintenance.
This set consists of an upper lamp assembly and a lower lamp assembly.

Type number : FLCL-16S (for upper and lower)

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12. APPEARANCE SPECIFICATIONS

<u>12-1. Appearance</u>

<div align="right">
Length ：L　[mm]
Width　：W　[mm]
Average diameter ：D　[mm]
</div>

	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 are not counted. Such as foreign particle between glass and polarizer film out of the display area, scratch on metal vessel, backlight module or polarizer film out of the display area, etc.

・These items are applied to the defects in the cell when backlight is on, and defects on the surface of the polarizer film at the display area.

・Inspector must observe the LCD screen from the normal direction unless specified. The distance between the LCD screen and the inspector should be 35cm or more.
One 20W fluorescent lamp is used at 50cm above the work table.
At this time, the illuminance at the vertical direction to the fluorescent lamp is 400 to 600lux (reference value).

<u>12-2. Dot defects (Bright spots, Dark spots)</u>

<u>12-2-1. Zone</u>

Inside display dot area (304.1× 228.1mm)

Display dot area means active area.

One pixel consists of 3 dots (red, green and blue).

<u>12-2-2. Bright spots</u>

(1) Bright spots are classified as follows. (based on brightness samples)
・These Visible under bias of 2% ND filter .... High bright spot R・G
・Visible under 5% but invisible under 2% ND filter ..... Low bright spot R・G・B
・Invisible under bias of 5% ND filter .... Not counted

(2) Bright spots by the light passing through tears, breaks, etc in color filter.
・Exceed size of a half dot .... High bright spot
・A half dot or less .... Not counted

(3) Bright spots by the light passing through tears, breaks, etc in chromium mask.
・Exceed 50μm .... High bright spot
・50μm or less .... Not counted

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 low-bright spot connections is up to 4.

12-2-4. Distance between Bright spots

・High-bright spots R and G .... 15mm or more
・High-bright spots and low-bright spot .... 5mm 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 5mm 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≤A<2/3 : Considered as 0.5 dot.

(c) 2/3≤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. Environmental Specifications

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

NOTE: Table 13-2 and Fig. 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

G (Top face)   J (Rear face)

C (Edge)

F (Side face)   E (Side face)

B (Edge)

A (Corner)

I (Front face)   D (Edge)   H (Bottom face)
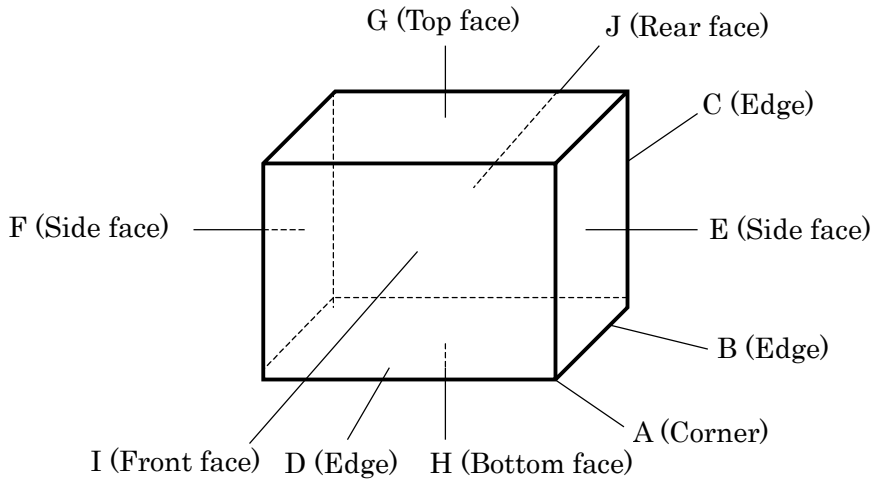
Fig.13-1. Direction to apply shock to package

14. INDICATIONS

This module has the following indications.

(1) Product name : LCD unit

(2) Model number : FLC38XGC6V-06

(3) Product drawing number : NA19020-C281 or NA19020-C291

(4) Manufacturing number : <u>8</u> <u>Y</u> <u>0</u> <u>0</u> <u>0</u> <u>1</u>

Serial number
(To be reset every month on 1st.)

Manufacturing month
(Oct. = X, Nov. =Y, Dec. =Z)

Last digit of manufacturing year.
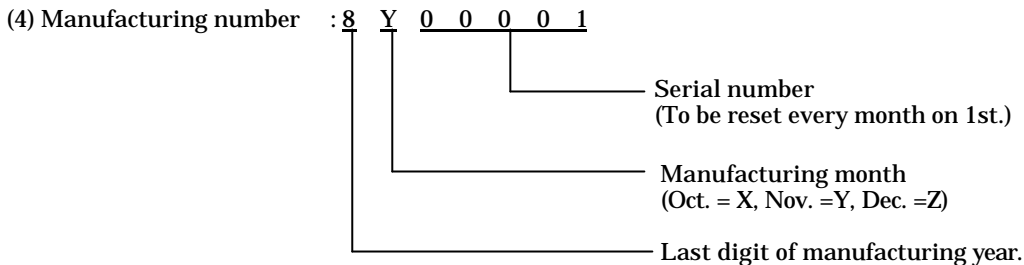
(5) Version number : 01A (Example)
-1st 2 digits "01" means operational version.
-3rd alphabet means functional version.

(6) Country of origin : MADE IN JAPAN (NA19020-C281)

MADE IN TAIWAN(NA19020-C291)

(7) Company name : FUJITSU LIMITED

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

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

THIS TFT COLOR LCD CONTAINS COLD CATHODE FLUORESCENT LAMPS. PLEASE FOLLOW LOCAL ORDINANCES OR REGULATIONS FOR ITS DISPOSAL.

Fig.14-1

WHEN CHANGING COLD CATHODE FLUO-RESCENT LAMPS, FOLLOW OPERATING SPECIFICATIONS. ESPECIALLY BE CAREFUL BOUT THE LAMPS SIDE-EDGE

Fig.14-2

LCD unit

FLC38XGC6V-06   0X50015
NA19020-C281   01A
MADE IN JAPAN/FUJITSU LIMITED
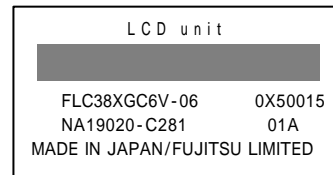
Fig.14-3 Product label (example)

15. PACKAGING

Separately specified in packaging specifications.

15-1. Packaging specifications

(1) 5 LCD modules / 1 package.

(2) Weight: approximately 10kg / 1 package.

(3) Outline dimensions : <u>371mm (W)×423mm (D) ×439mm (H)</u>

15-2. Packaging method

Fig.15-2 (a),(b),(c),(d) show the packing method.

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Front side

Protective sheet

Tape

Rear side

Anti-Electric Bag
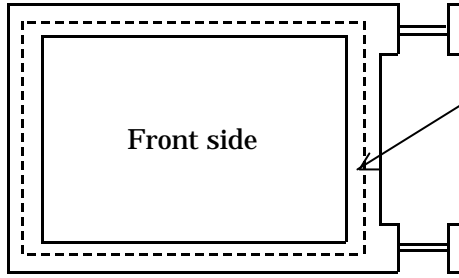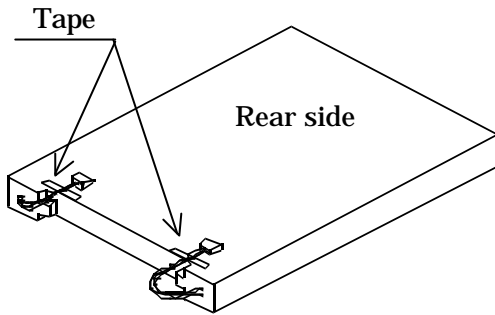
Front side

Fig.15-2(a) Packaging Method

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F

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1

Holder(bottom)

LCD unit

Holder(upper)

(462)

(268) (353)

Label(example)

(TYPE)	FLC38XGC6V-06	(QTY.)	5
	NA19020-C281		01A
(DRWG. NO.)		(REV. NO.)	

9X00001
9X00002
9X00003
9X00004
9X00005

MADE IN JAPAN

• Taping
  Upper : H or I method
  Bottom : H method
• Upper and bottom holders should be
  anti-electrostatic type.

<u>Fig.15-2(b) Packaging Method</u>

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1

Upper Board

Corrugated

PP Belt

1980(By Ship)
1520(By Airplane)

Carton Angle

900   900

Wrap Film
Up and Down : 3 times wrap
Middle   : 2 times wrap

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

Fig.15-2(c) Packaging Method

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1

Corrugated carton(A)
With LCD modules

Cushioning material

617
(585)

Corrugated fiberboard shipping container(B)

496
(480)

616
(600)
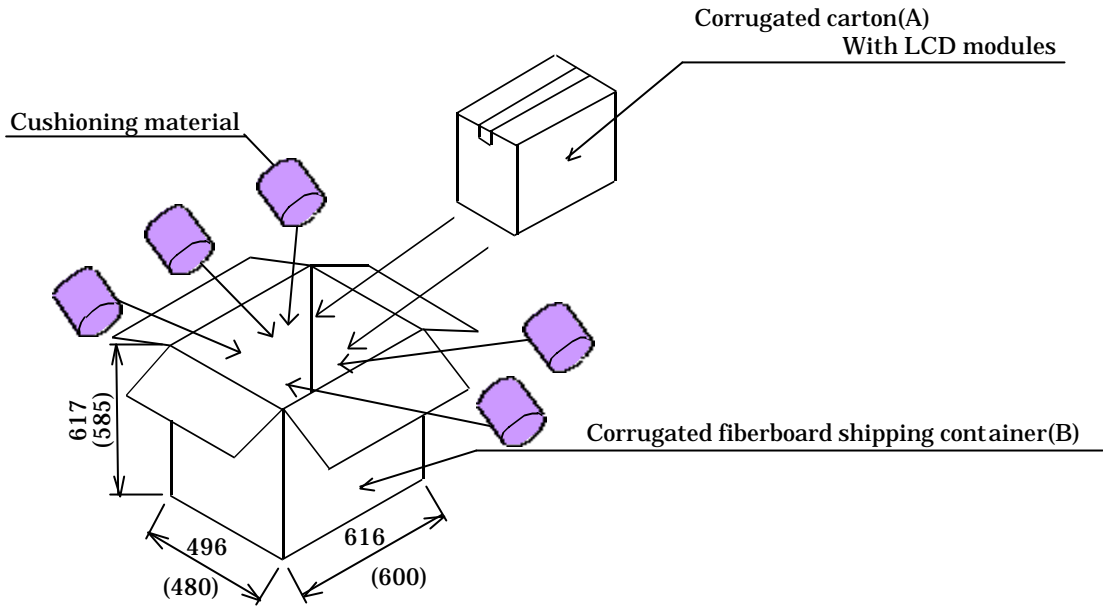
Note 1) The carton (A) should be placed in the middle of the container(B) with enough cushioning materials.

Note 2) The figures in ( ) show inside measurements of the container(B).

Figure.15-2(d) Packaging Method

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16.WARRANTY

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 properly use this LCD module.

(1) Application

The information contained in this document are not intended for the use of this LCD as a equipment which requires extremely high reliability such as aerospace equipment, nuclear control systems and medical for life support.

(2) Handling of LCD panel

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

Do not press hard on the LCD panel surface.
In the LCD panel, the gap between two glass plates is kept precisely and uniformly to maintain display's characteristics and reliability. If this panel is pressed hard, the following troubles occurs.
    (a) Ununiformity of color
    (b) Orientation of liquid crystal becomes disordered
Problem (a) returns to normal after a while. Problem (b) returns to normal if power is shut off once then turned on again.
However these operations should be avoided to insure reliability.

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 stained.
•For If the display surface is stained 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] Wipe off lightly with a soft cloth after soaking in the clear water and squeezing hard out of water drops. Only if the dirt is hardly wiped off, use isopropyl alcohol or ethanol.
    Be careful not to splash the water or the solvent and water penetrated between the polarizer and the LCD panel.
    Do not use solvents such as ketone (acetone, etc.) and aromatics (xylene, toluene, etc.)
•If saliva or water drops are left for long time, it may deform partial deformation 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.

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

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A

(3) Handling of LCD module

Do not pull the cold-cathode tube cable strongly.
If the cable is pulled with the loaf of 2kg or more, the cable may be damaged or reliability may decrease.

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

Take anti-static measures for assembling the module.
Since the LCD module contains CMOS-ICs, the following considerations are necessary.

- For assembling the module, operator should be grounded and wear cotton or conductive gloves.

- Floor of work area and work table to assemble the LCD module should be covered with electrostatic shielding in order to 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 under low humidity (50%RH or less).

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

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

Adhere to the specified power supply sequence.
If not followed, the CMOS-IC may cause a latch-up, or the DC voltage may be applied the liquid crystal, and a failure or serious deterioration in display quality may occur.

Do not operate the LCD module when condensation is present.
If the LCD module is operated when condensation is on the terminals of the LCD panel, the terminals cause electrochemical reaction, and may reach disconnection. Condensation easily occurs especially when the module is moved from a cold environment to a warm environment.

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

- Operation at high temperature (>50ºC)   :Display colors shift to blue.

- Storage at high temperature (>60ºC) :The polarizer film deteriorates and contras decreases.

- Operation at low temperature (<0ºC)   :The response speed decreases considerably.

- Storage at low temperature (<-20ºC) :The liquid crystal may solidify and become damaged.

Always input the control signals at the correct timing.
If control signals (DCLK, or ENAB) are not input, or if the timing is out of the specified timing, DC voltage may be applied to the liquid crystal and, as a result, cause image sticking or deterioration of contrast.

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(5) Precautions on designing module mounting

Do not press the display surface and bottom face of the LCD module.
Display quality or reliability may be deteriorated if the installation of the LCD module is inappropriate and, as a result, excessive pressure is applied to the surface of LCD screen. Brightness uniformity or the reliability of CCFL may decrease if the pressure is applied to the backlight module.

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

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

Do not make the power cable of the backlight clung to a metal plate, etc.
Backlight frequency current for backlight driving may leak to the metal and desired brightness may not be assured.

When Mounting LCD module with M4 screw (x4) should be screw up under 5.75kgf torque.

(6) Storage method

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

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

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

Recommended storage environment
•Place   :Dark (avoid direct sunlight)
•Temperature : 10~35ºC
•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.

18. OTHERS

!   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 cloths, wash it off with soap immediately. Follow precautions for regular electronic components.

Solder flux on the printed circuit board is harmless to the quality and reliability of LCD module.
Fujitsu is practicing non-wash technology on module assembly process.

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