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ECR #	Rev. Hist.	Description	Approved	Date
	A	First Release	Ion Cenuse	12/12/99

Technical Specification

AA084VB02

8.4-inch TFT-LCD Module

For

Industrial Applications

Approvals		Date
MELA Eng.	Ion Cenuse	Dec. 3RD, '99
MELA Mktg.	Dale Maunu	
Mitsubishi/ADI		

MITSUBISHI ELECTRIC

TFT-LCD Module
8.4-inch VGA Color
AA084VB02

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1. OVERVIEW

1.1. Description: AA084VB02 is a 8.4-inch color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight. By applying 6 bit digital data 640 x 480, 262K – color images are displayed on the 8.4-inch diagonal screen. Input power voltage is 3.3 V (does not includes power for the backlight). Both 3.3V-CMOS and 5.0V-CMOS voltage levels are acceptable for logic input voltage. Inverter for backlight is not included in this module.

1.2. General specifications summary table:

ITEM	SPECIFICATION
Display Area (mm)	170.9 X 128.2 (8.4-inch diagonal)
Number of Pixels	640(H) X 480(V)
Pixel Pitch (mm)	0.267(H) X 0.267 (V)
Color Pixel Arrangement	RGB Vertical Stripe
Display Mode	Normally White
Number of colors	262K
Wide Viewing Angle Technology	Optical Compensation Film
Optimum Viewing Angle (Contrast Ratio)	12 O'clock
Brightness (cd/m^2)	350
Power Consumption (W)	5.4
Module Size (mm)	221.0(W) X 152.4(H) X 10.58 (D)
Module Weight (g)	420
Backlight Unit	CCFL, Two Lamps, Replaceable

1.3. Product Disclaimer

The LCD products listed in this document are not suitable for safety related applications that do not have redundant back-up system(s). In other words, these LCD products are not designed for use as a single source safety related application, and therefore, are not recommended for applications in which human life and/or environment may be affected in the event of the failure of the LCD product. More specifically, if there is no back-up system or product in place that will continue operating the system, the LCD products should not be used in such things as:

(i) aircraft navigation or aerospace equipment;
(ii) nuclear reactor control systems;
(iii) any application where failure or inaccuracy might cause death or personal injury (e.g., life support systems); or
(iv) military and submarine critical systems.

The LCD products are designed for typical industrial applications such as, but not are limited to the following: computers, office equipment, industrial controllers, audio and visual equipment, test and measurement devices, communication equipment, point of sale, medical imaging and automotive and various other consumer products. If there are any questions regarding the use, ability or application of these LCD products, please contact an authorized sales representative.

2. ABSOLUTE MAXIMUM RATINGS

2.1. Environmental conditions: humidity ≤85% RH, no condensation

2.2. Summary Table:

ITEM	SYMBOL	MIN	MAX	UNIT
Power Supply Voltage for LCD	V_{CC}	–0.3	5.5	V
Logic Input Voltage	VIN	0	7	V
Operating Temperature	T_{op}	0	50	°C
Storage Temperature	T_{stg}	–20	60	°C

3. ELECTRICAL CHARACTERISTICS

3.1. Conditions: TFT-LCD module ambient temperature is 25°C

3.2. Summary table:

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	COMMENTS
Power Supply Voltage for LCD*		V_{CC}	3.0	3.3	3.6	V	(Note)
Power Supply Current for LCD*		I_{CC}		240	400	mA	(Note)
Permissive Input Ripple Voltage		V_{RP}			100	mV_{p-p}	V_{CC}=+3.3V
Logic Input Voltage	High	V_{LH}	2.4		5.5	V	
	Low	V_{LL}	0.0		0.8	V	

Note * : See paragraph 3.4

3.3. Backlight

3.3.1. The table below shows data for one lamp only.

3.3.2. The TFT-LCD module has two identical lamps operated independently.

3.3.3. Operation of both lamps is required in order to meet all the parameters in the AA084VB02 specification.

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Lamp Voltage	V_L		465		V
Lamp Current	I_L		5.0 *		mA
Lamp Starting Voltage	V_S	980			V

Note * : For typical luminance of 350cd/m^2

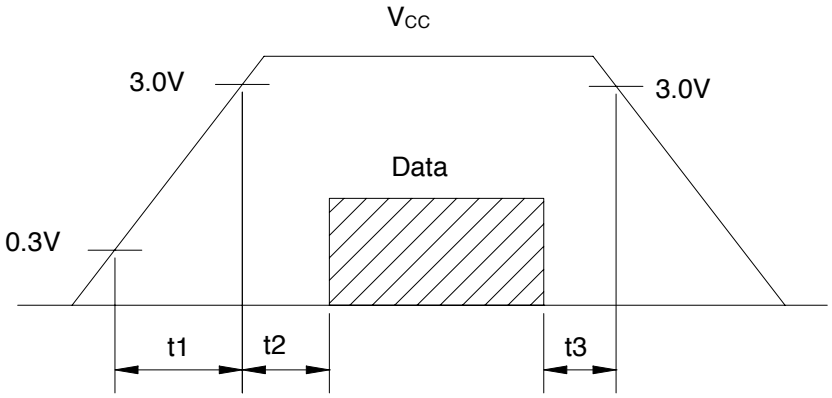
3.4. Notes

3.4.1. V_{CC} turn-on conditions :

t1 ≤ 10ms

0 < t2 ≤ 50ms

0 < t3 ≤ 50ms

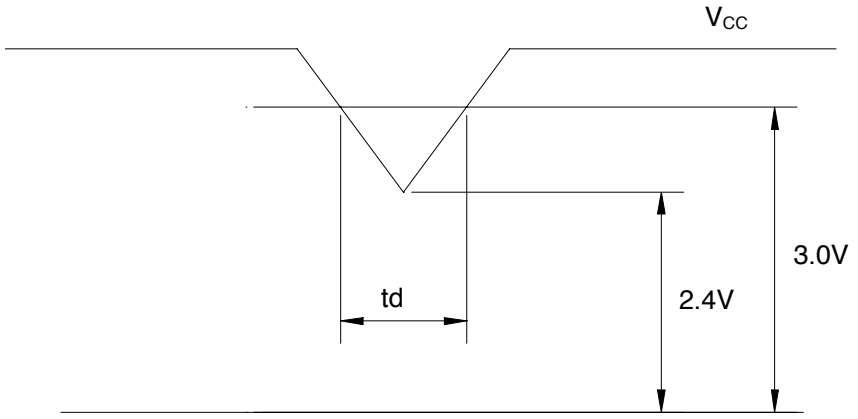


3.4.2. V_{CC}-dip conditions :

2.4V ≤ V_{CC} < 3.0V and td ≤ 10ms

V_{CC} < 2.4V

V_{CC}-dip conditions should also follow the V_{CC} turn-on conditions.



3.4.3. Test condition for I_{CC} Typical:

64 gray-bar pattern

480 line mode

V_{CC} = +3.3V

3.4.4. Test conditions for I_{CC} (MAX) :

1 X 1 checkerboard, black and white pattern

DC input voltage = 3.3V

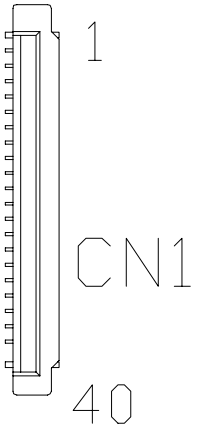
4. INTERFACE CONNECTORS PIN ASSIGNMENT

4.1. Used connector: IL-FPR-40S-VF-E1500(JAE)

4.2. Input connector pin assignment table:

PIN	SYMBOL	FUNCTION
1	V_{CC}	3.3V Power Supply
2	V_{CC}	3.3V Power Supply
3	NC	Open
4	GND	Ground
5	TEST	This pin should be open. Test signal output for only internal test use.
6	TEST	This pin should be open. Test signal output for only internal test use.
7	HREV	Horizontal reverse scan (See paragraph 7.3)
8	VREV	Vertical reverse scan (See paragraph 7.3)
9	GND	Ground
10	DENA	Data enable signal (to settle the viewing area)
11	GND	Ground
12	B5	BLUE data signal (MSB)
13	B4	BLUE data signal
14	B3	BLUE data signal
15	GND	Ground
16	B2	BLUE data signal
17	B1	BLUE data signal
18	B0	BLUE data signal (LSB)
19	GND	Ground
20	G5	GREEN data signal (MSB)
21	G4	GREEN data signal
22	G3	GREEN data signal
23	GND	Ground
24	G2	GREEN data signal
25	G1	GREEN data signal
26	G0	GREEN data signal (LSB)
27	GND	Ground
28	R5	RED data signal (MSB)
29	R4	RED data signal
30	R3	RED data signal
31	GND	Ground
32	R2	RED data signal
33	R1	RED data signal
34	R0	RED data signal (LSB)
35	GND	Ground
36	HSTNC	Horizontal sync signal
37	VSYNS	Vertical sync signal
38	GND	Ground
39	CLK	Clock signal for sampling catch data signal
40	GND	Ground

Top view of input connector pin assignment



*Note: The metal frame of the TFT-LCD module is connected to ground.

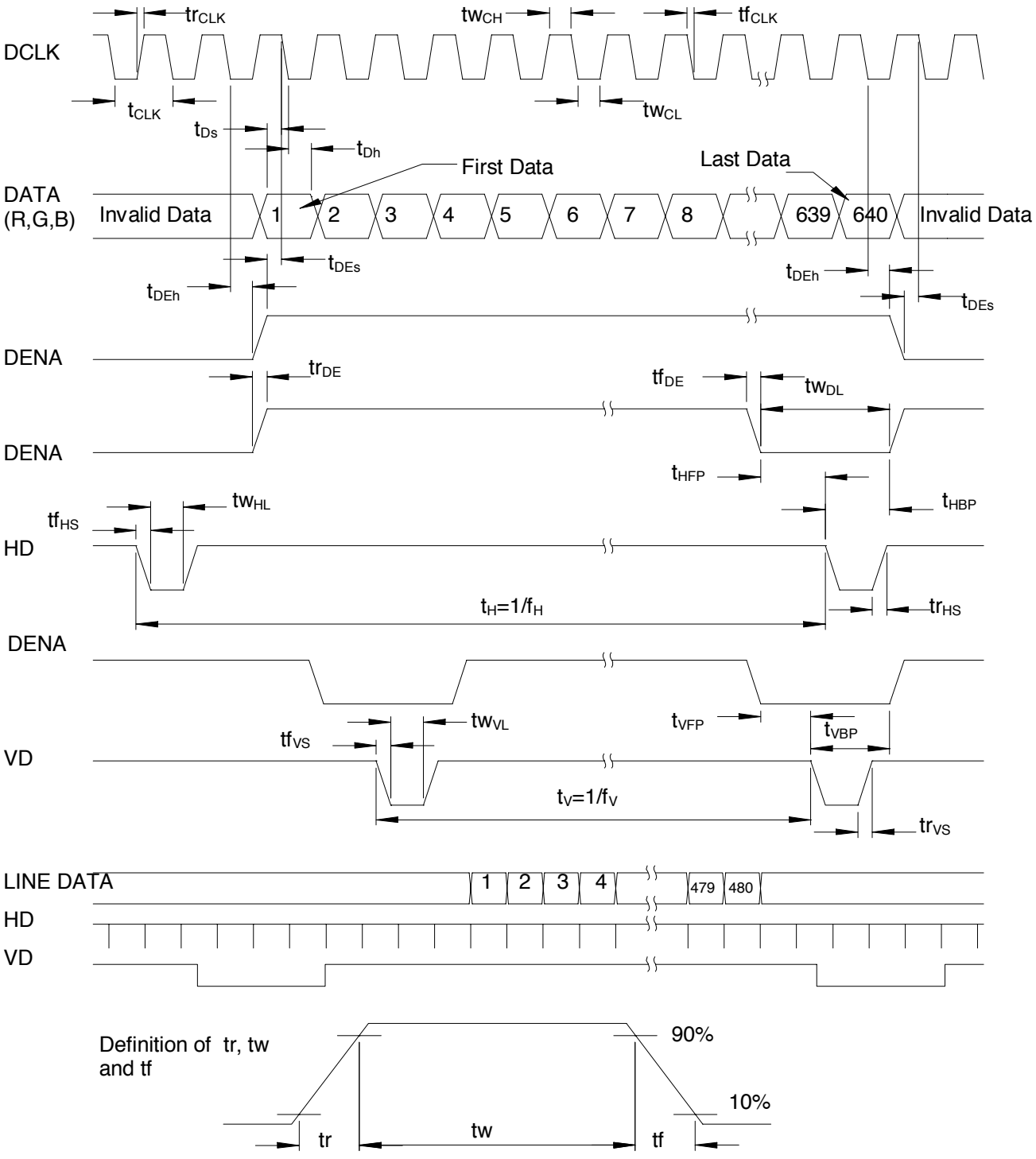
4.3. Backlight connector type (See paragraph 6)
Backlight connector (CN2 and CN3): BHR-03VS-1 (JST)
Backlight mating connector: SM02(8.0)B-BHS-TB (JST)

4.4. Backlight connector pin assignment table:

PIN NUMBER	SYMBOL	FUNCTION
1	CTH	VBLH(High voltage)
3	CTL	VBLL(Low voltage)

5. INTERFACE TIMING

5.1. Timing Chart



SIZE	MITSUBISHI ELECTRIC SPECIFICATION	REV.				
A	AA084VB02	A	SHEET	8	OF	21

5.2. Timing Specification

ITEM		SYMBOL	MIN	TYP	MAX	UNIT
DCLK *	Frequency	f_{CLK}	20	25	30	MHz
	Period	t_{CLK}	33.3	40	50	ns
	Width-Low	tw_{CL}	10	—	—	ns
	Width-High	tw_{CH}	10	—	—	ns
	Rise Time	tr_{CLK}	—	—	5	ns
	Fall Time	tf_{CLK}	—	—	5	ns
DATA (R, G, B)	Set up Time	t_{Ds}	5	—	—	ns
	Hold Time	t_{Dh}	5	—	—	ns
DENA	Set up Time	t_{DEs}	5	—	—	ns
	Hold Time	t_{DEh}	5	—	—	ns
	Low Time	tw_{DL}	90	—	168	t_{CLK}
	Rise Time	tr_{DE}	—	—	5	ns
	Fall Time	tf_{DE}	—	—	5	ns
	Horizontal Front Porch	t_{HFP}	0	—	—	t_{CLK}
	Horizontal Back Porch	t_{HBP}	7	—	—	t_{CLK}
	Vertical Front Porch	t_{VFP}	1	20	—	t_H
	Vertical Back Porch	t_{VBP}	8	20	—	t_H
HD*	Frequency	f_H	27	31.5	38	kHz
	Period	t_H	730	—	808	t_{CLK}
	Width Low	tw_{HL}	5	—	—	t_{CLK}
	Rise Time	tr_{HS}	—	—	10	ns
	Fall Time	tf_{HS}	—	—	10	ns
VD	Frequency	f_V	55	60	70	Hz
	Period	t_V	489	—	—	t_H
	Width Low	tw_{VL}	3	—	—	t_H
	Rise Time	tr_{VS}	—	—	10	ns
	Fall Time	tf_{VS}	—	—	10	ns

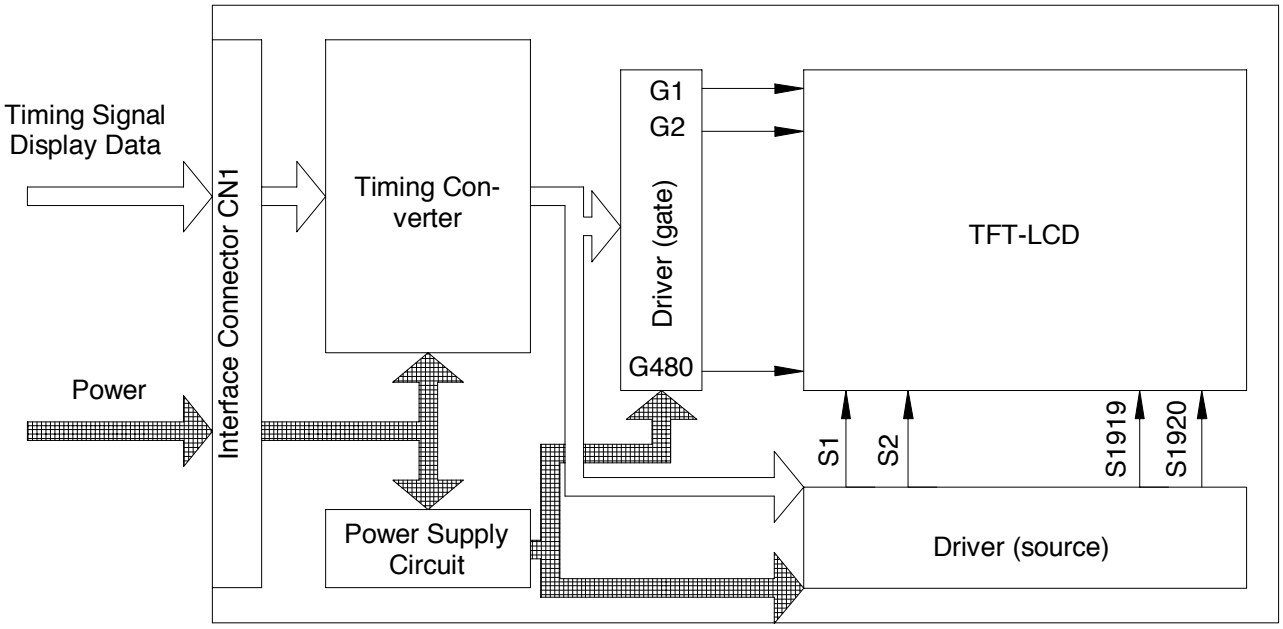
Note 1: DCLK and HD should be applied continuously at the input connector of the TFT-LCD module during operation, subject to V_{CC} turn-on conditions.
Note 2: Accepted only 640 data and 480 lines.
Note 3: Both HREV and VREV should be stable during operation.

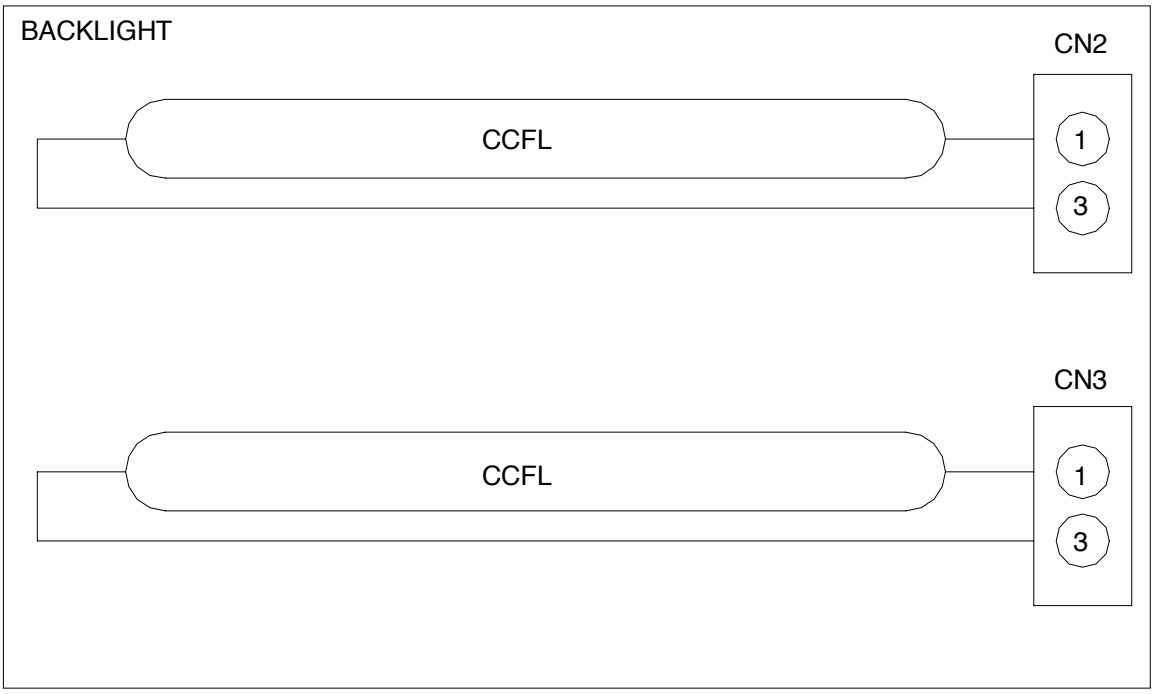
5.3. Color Data Assignment

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	⋮																		
	⋮																		
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	⋮																		
	⋮																		
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	⋮																		
	⋮																		
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

5.3.1. Definitions
Gray scale: Color (n) → n indicates gray scale level.
Data: 1=High, 0=Low

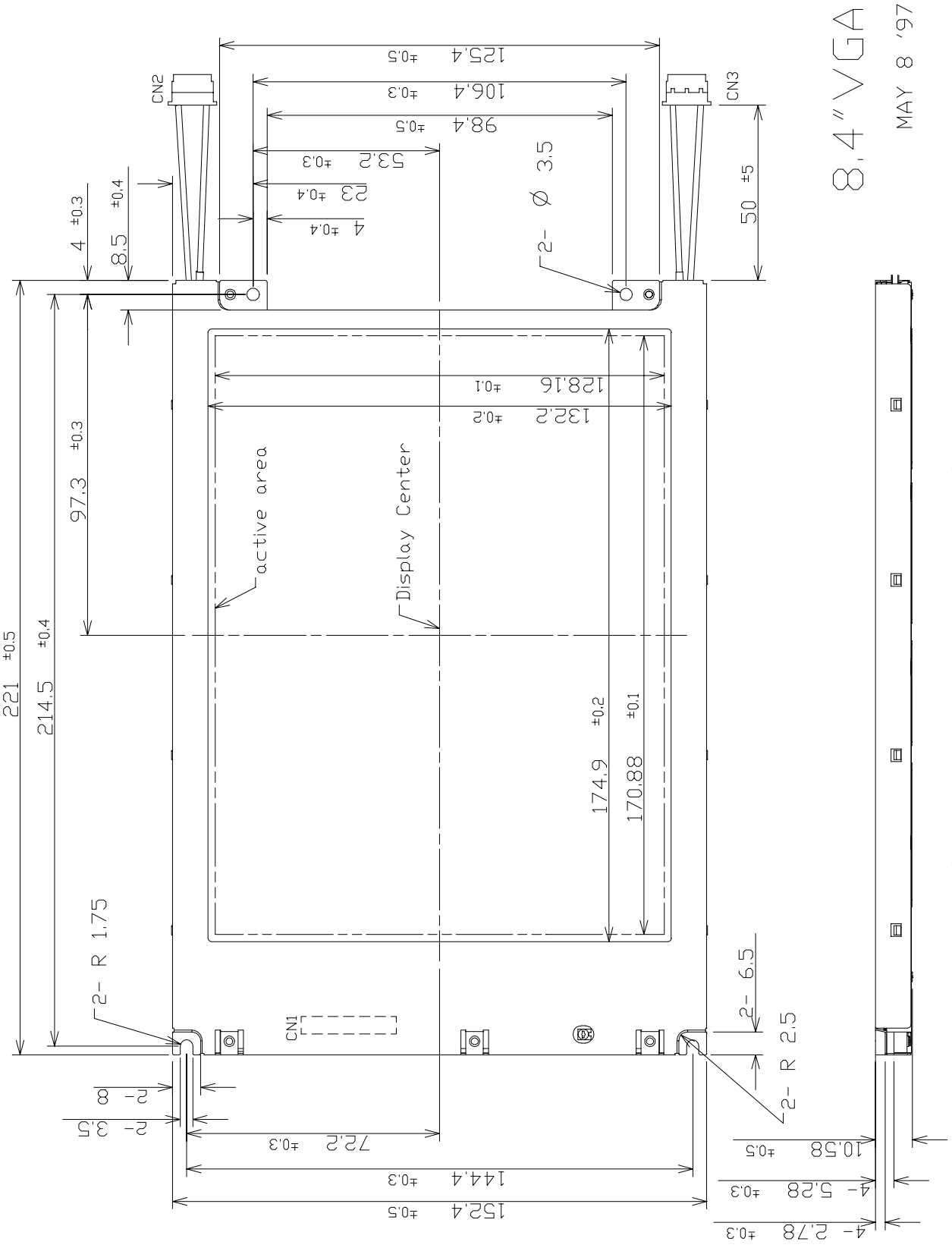
6. BLOCK DIAGRAM





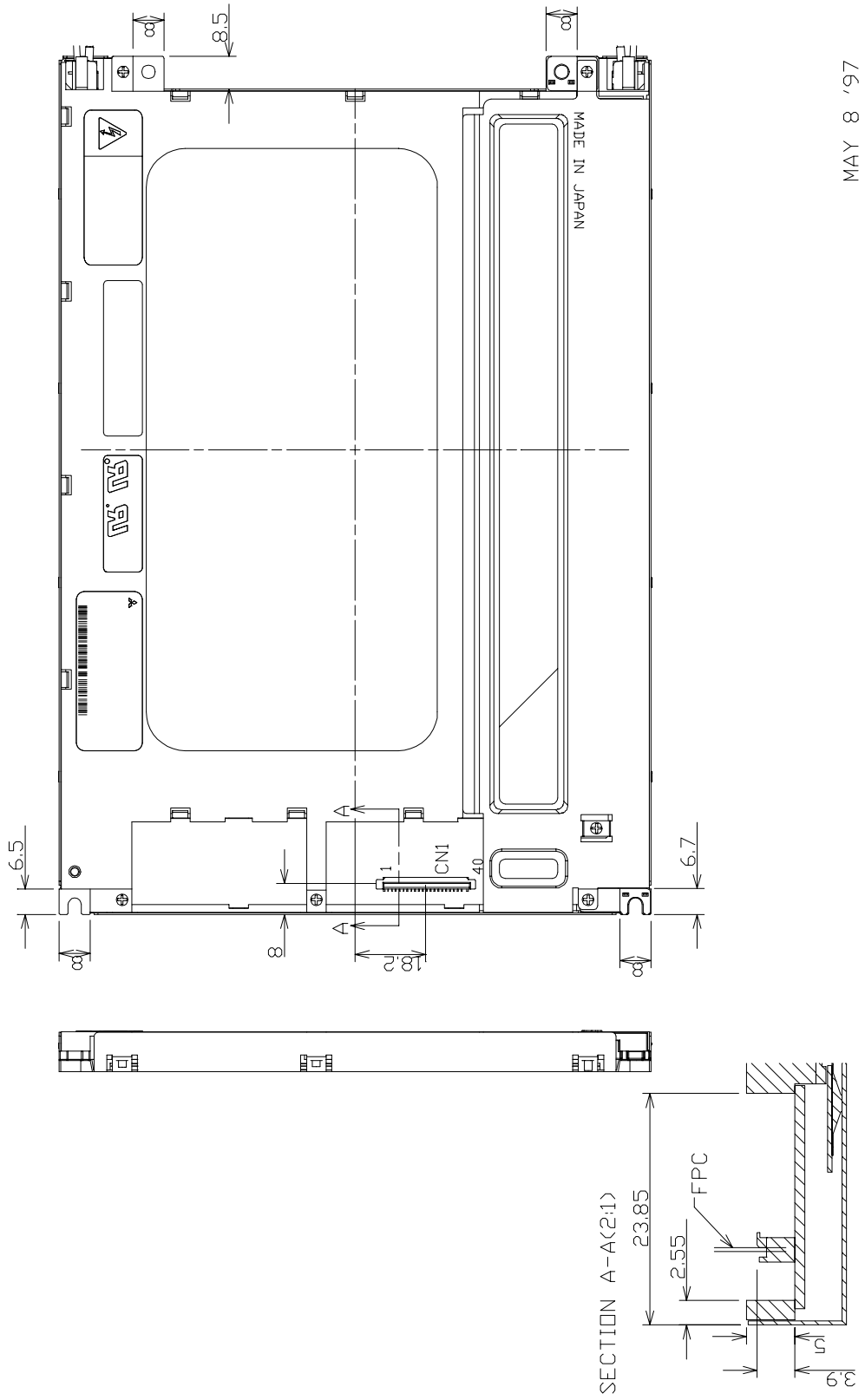
7. MECHANICAL SPECIFICATION

7.1. Front Side Drawing



*Note: The connector CN1 is located on the rear side of the TFT-LCD module.
Undefined tolerances are ±0.5mm

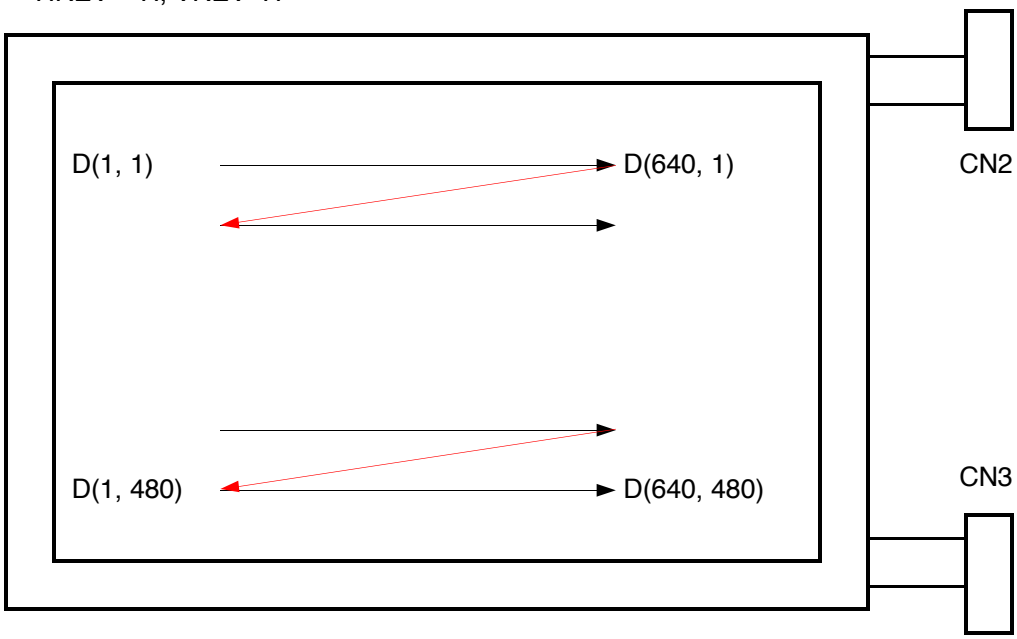
7.2. Rear Side Drawing



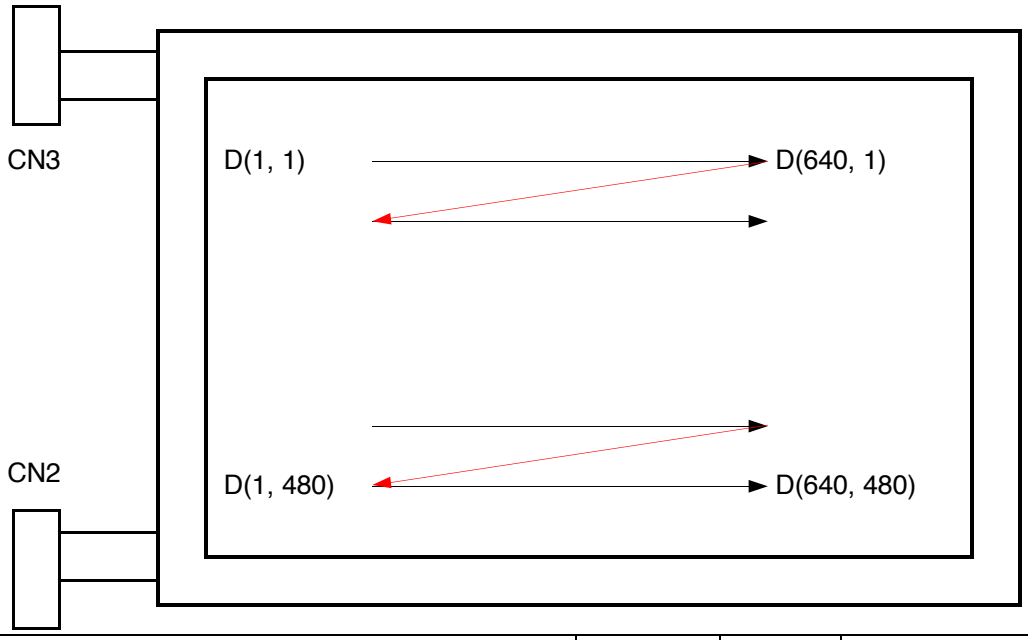
7.3. Scanning direction

This module has the capability of inverting scan direction by signaling from controller. Both horizontal and vertical scan direction can be selected independently. Note that scan direction cannot be changed during operation.
The following figure show how to scan the display image data on the LCD screen.
The both image data sequences are the same.

7.3.1 Normal scan
HREV = H, VREV=H



7.3.2 Reverse scan
HREV = L, VREV=L



8. OPTICAL CHARACTERISTICS

8.1. Test conditions: Ta=25°C, V_{CC}=3.3V, IL=5mA conditions. All measurements made using BM-5A (TOPCON) or LCD-7000 (Otsuka Electronic) in a dark room, under no ambient light conditions.

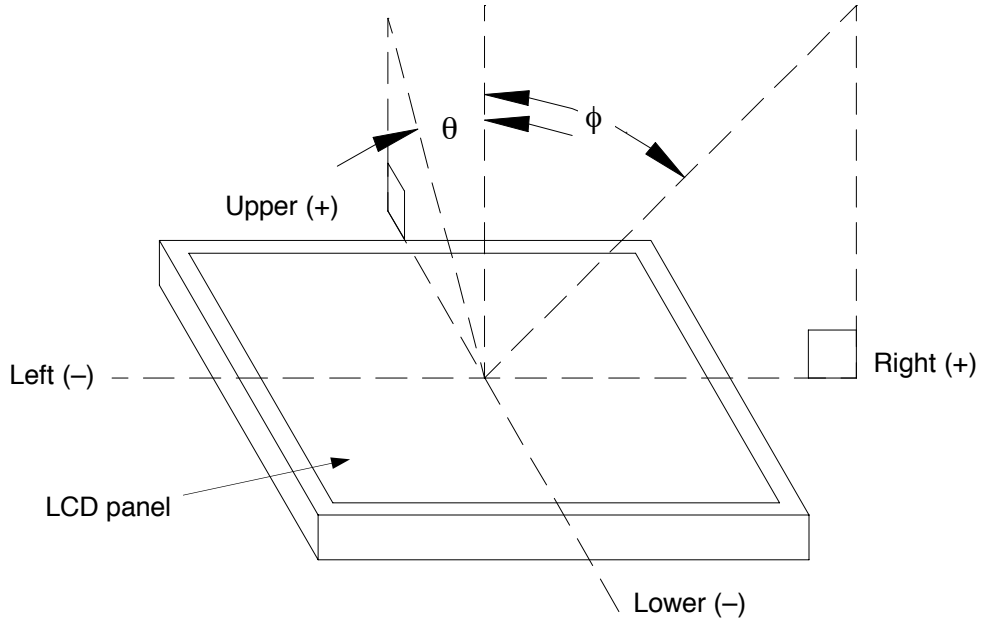
8.2. Summary table:

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Contrast Ratio		CR	$\theta = \phi = 0°$	—	300	—	
Luminance		L	$\theta = \phi = 0°$	—	350	—	cd/m^2
Response Time		tr	$\theta = \phi = 0°$	—	20	—	ms
		tf	$\theta = \phi = 0°$	—	30	—	ms
Viewing Angle	Horizontal	ϕ	CR ≥ 10	—	–60~60	—	°
	Vertical	θ		—	–40~50	—	°
Color Coordinates	Red	x y	$\theta = \phi = 0°$	— —	0.563 0.336	— —	—
	Green	x y		— —	0.330 0.535	— —	
	Blue	x y		— —	0.159 0.150	— —	
	White	x y		— —	0.330 0.340	— —	
Haze value of polarizer		H		—	12	—	

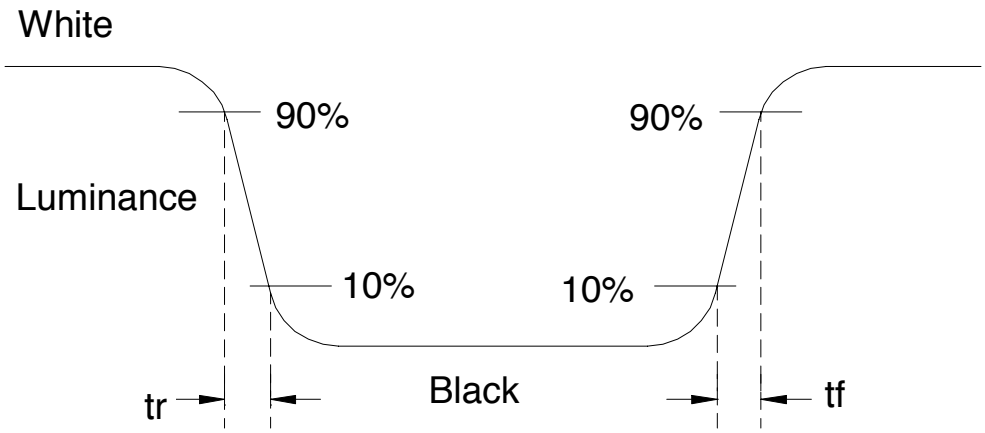
8.3. Definitions

8.3.1. Contrast Ratio CR = ON (White) Luminance / OFF (Black) Luminance

8.3.2. Viewing Angle (θ , ϕ) - See drawing below :



8.3.3. Definition of Response Time tr and tf:



9. RELIABILITY TEST CONDITIONS

9.1. Temperature and Humidity

TEST ITEM	CONDITIONS
High Temperature and High Humidity Operation	40 °C, 90%RH 500 hours
High Temperature and High Humidity Storage	60 °C, 90%RH 96 hours
Lowe Temperature Storage	–20 °C, 96 hours
Thermal Shock (non-operating)	Between –20°C(1 hour) and 60°C(1 hour) 5 cycles

9.2. Shock and Vibration

TEST ITEM	CONDITIONS
Shock (non-operating)	Shock level: 1470 m/s^2 (150G) Waveform: half sinusoidal wave, 2 ms Number of shocks: one shock input in each direction of three mutually perpendicular axis for a total of six shock inputs
Vibration (non-operating)	Vibration level: 9.8 m/s^2 (1.0G) Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave/min Duration: one sweep from 5 to 500 to 5Hz in each of three mutually perpendicular axis (total 3hr)

9.3. Judgment Standard – Pass/Fail criteria for reliability tests is defined as follow:
Pass: Normal display image with no obvious non-uniformity and no line defect.
Fail : No display image, obvious non-uniformity, or line defect.

10. LIFE TIME OF THE BACKLIGHT LAMP

10.1. Definitions

10.1.1. Lamp end of life is defined as the luminance of it become half of the initial value or lamp does not turn on under 980V at 25°C.

10.1.2. The life time of the backlight lamp depends on the ambient temperature. The life time may be different from the time specified in the table below if the lamp is operated under extreme temperature conditions.

10.2. Summary Table

ITEM	SYMBOL	CONDITION	SPECIFICATION		UNIT
			MIN	TYP	
Life Time	T_L	IL=5.0mA,Ta=25°C	50,000	—	hour

12. HANDLING PRECAUTIONS FOR TFT-LCD MODULE - Please observe the recommendations included in this paragraph when handling the TFT-LCD modules!

12.1. ASSEMBLY PRECAUTIONS

12.1.1. Please use the mounting hole on the module corners for installation and avoid bending or wrenching LCD during assembly process. Do not drop, bend or twist the TFT-LCD module during handling.

12.1.2. Guidelines for designing the TFT-LCD module enclosure:

12.1.2.1. Housing case must be designed carefully so as not to put stresses on LCD all sides and not to wrench module. Mechanical stress to the TFT-LCD module may degrade the reliability and overall performances of the display (like brightness uniformity degradation…etc.).

12.1.2.2. Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0 mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.

12.1.2.3. When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when additional parts are inserted for EMI countermeasures.

12.1.2.4. Choose carefully the inverter location to avoid any stress to the lamp cable. The lamp cable also should not interfere with the module installation into the enclosure.

12.1.2.5. Keep sufficient clearance between LCD module and the others components, such as inverter and speaker so as not to interfere with the LCD module. Approximately 1.0 mm of the clearance in the design is recommended.

12.1.3. Do not apply pressure or scratch LCD panel surface with anything hard. Do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)

12.1.4. Do not apply pressure on any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If applying pressure to the TFT-LCD module is unavoidable, handle the LCD module with care not to damage them.

12.1.5. Wipe out LCD panel surface with absorbent cotton or soft cloth to clean the surface.

12.1.6. Wipe out immediately any liquids which may have accidentally being sprayed on LCD panel surface. Droplets on the LCD panel surface may alter the quality of the image.

12.1.7. Do not disassemble the TFT-LCD module for any reasons. By doing so you void the warranty of the TFT-LCD module and is very likely that the performances will be degraded considerably.

12.1.8. Do not touch metal frames with bare hands and soiled gloves. If fingerprints or dirt are not cleaned immediately with solvent it is very likely that permanent marks will be left on the metal surfaces.

12.1.9. Disconnect the lamp wires before handling the inverter otherwise is possible to damage the lamp and or the lamp wires by pulling it together with the inverter.

12.2. OPERATING PRECAUTIONS

12.2.1. Turn off the power supply before connecting and disconnecting signal input cable.

12.2.2. Do not change the setting of the adjustable resistors on TFT-LCD module subassemblies. The adjustable resistors are properly set at the factory and any deviation from the factory setting will compromise the performances of the TFT-LCD module.

12.2.3. When evaluating the optical characteristics of the display please note that will take longer time for the backlight to stabilize if the ambient temperature is at the lower end of the temperature range.

12.2.4. Sudden changes of the ambient temperature may cause condensation on various surfaces of the TFT-LCD module and degrade the overall performances until the surfaces become dry again.

12.2.5. Follow-up the general safety rules applying to generic electronic products.

12.3. PRECAUTIONS WITH ELECTRONICS

12.3.1. This LCD module uses CMOS integrated circuits and other components subject to be affected by electrostatic discharges. Use ESD protection equipment and follow all ESD safety procedures when handling the TFT-LCD modules.

12.3.2. Please remove protection film very slowly from the surface of LCD module to prevent from high level electrostatic discharges. It is recommended to lift the protection film starting from the corner of the glass in proximity of the source and gate PWB ending at the corner of the glass furthest away from the electronics.

12.4. STORAGE PRECAUTIONS

12.4.1. When you store LCDs for a long time, it is recommended to keep the temperature between 0°C ~ 40 °C without the exposure of sunlight and to keep the humidity less than 90%RH.

12.4.2. Do not leave the LCDs in the environment of high humidity and high temperature such as 60°C 90%RH.

12.4.3. Do not expose the TFT-LCD modules to temperatures below –20°C.

12.5. SAFETY PRECAUTIONS

12.5.1. When disposing LCDs it is recommended to break them into pieces. The broken pieces should be washed with solvents such as acetone and ethanol. The residual solvent from this process should be burned.

12.5.2. If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash it off thoroughly with soap and water.

12.6. OTHERS

12.6.1. Exposing the TFT-LCD module to strong incident light may negatively affect the display characteristics because of polarizer film, color filter, and other materials degradation. Do not expose LCD module to direct sunlight or light with strong ultraviolet content.

12.6.2. Avoid any contact of the TFT-LCD module front surface with other objects or materials.

12.6.3. Packaging and shipping

12.6.3.1. Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Do not open the packaging box unnecessarily.

12.6.3.2. Do not stack more than 5 boxes on top of each other because stack of 5 is maximum designed limit. Do not turn over the boxes.

12.6.3.3. Avoid excessive shock, the shipping boxes are not designed to be thrown. Excessive vibrations can also damage the boxes and the TFT-LCD modules inside.

12.6.3.4. Packaging box and the inner structures of it are made of cardboard. Avoid to have the boxes in contact with water or in high humidity environment which may cause the carton to become soft, or to break, damaging the TFT-LCD modules inside.

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