

AMP DISPLAY INC.

SPECIFICATIONS

2.0 COLOR TFT MODULE

CUSTOMER:	
CUSTOMER PART NO.	
AMP DISPLAY PART NO.	AM176220NTNQW-T00H
APPROVED BY:	
DATE:	

APPROVED FOR SPECIFICATIONS

APPROVED FOR SPECIFICATION AND PROTOTYPES

AMP DISPLAY INC

9856 SIXTH STREET RANCHO CUCAMONGA CA 91730 TEL: 909-980-13410 FAX: 909-980-1419 WWW.AMPDISPLAY.COM

RECORD OF REVISION

Revision Date	Page	Contents	Editor
2006/09/14	-	New Release	Alen
2006/09/21	3	Change Main LCD Driver IC. to ILI9221.	Alen
2006/10/16	-	Issued official specifications.	Alen
		Rename TF176220-79-1 to AM-176220NTNQW-T00H.	
2006/11/07	29	Addition the packing condition.	Emil

1 Features

This single-display module is suitable for cell phone application. The Main-LCD adopts one backlight with High brightness 3-lamps white LED.

(1) Construction: 2.0" a-Si color TFT-LCD, White LED Backlight, and FPCB.

(2) Main LCD : 2.1 Amorphous-TFT 2.0 inch display, transmissive, Normally white type, 12 o'clock.

- 2.2 176(RGB)X220 dots Matrix, 1/220 Duty.
- 2.3 Narrow-contact ledge technique.
- 2.4 Main LCD Driver IC: ILI9221
- 2.5 Real 65K colors display:

Red-5bit, Green-6bit, Blue-5bit (8-bit twice interface)

- (3) Low cross talk by frame rate modulation
- (4) Direct data display with display RAM
- (5) Partial display function: You can save power by limiting the display space.
- (6) MPU interface: 8-bit twice 80-Series, parallel interface.
- (7) Abundant command functions:

Area scroll function

Display direction switching function

Power saving function

Electric volume control function: you are able to program the temperature compensation function.

2 Mechanical specifications

Dimensions and weight	Dimensior	ns and	weight
-----------------------	-----------	--------	--------

Item		Specifications	Unit
External shape dimensions		*37.68(W) x 56.0(H) x 4.2 (D) Max.	mm
Main	Pixel size	0.18 (W) x 0.18 (H)	mm
LCD	Active area	31.68 (W) x 39.6 (H)	mm
	Color filter area	35.48 (W) x 43.4 (H)	mm
	Weight	11.1	g

*1. This specification is about External shape on shipment from AMPIRE.

3 Absolute max. ratings and environment

			Ta=25	°C G	ND=0V
Item	Symbol	Min.	Max.	Unit	Remarks
Power voltage	VDD – GND	-0.3	+3.3	V	
Power voltage	LED A – LED K	-0.5	+12.0	V	Serial
Input voltage	VIN	-0.5	VDD	V	

3-1 Absolute max. ratings

3-2 Environment

Item	Specifications	Remarks
Storage	Max. +70 °C	Note 1:
temperature	Min20 °C	Non-condensing
Operating	Max. +60 °C	Note 1:
temperature	Min10 °C	Non-condensing

Note 1 : Ta \leq +40 °C · · · Max.85%RH

Ta>+40 $^{\circ}$ C • • • • The max. humidity should not exceed the humidity with 40 $^{\circ}$ C 85%RH.

4 Electrical specifications

4-1 Electrical characteristics of LCM

(V_{DD}=3.0V, Ta=25 °C)

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
IC power voltage	V_{DD}		2.4	3.0	3.3	V
High-level input voltage	V _{IHC}		0.8V _{DD}		V_{DD}	V
Low-level input voltage	V _{ILC}		0		$0.2V_{DD}$	V
Consumption current of VDD	I _{DD}	LED OFF	-	4	5	mA
Consumption current of LED	I _{LED_ON}	V _{LED_ON} =10V	-	15	20	mA

※ 1. 1/220 duty.

4-2 LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V _f	I _f =15mA	9	10	12	V
Reverse voltage	Vr		-	-	12	V
Forward current	l _f	3-chip serial	12	15	20	mA
Power Consumption	P _{BL}	I _f =15mA	-	160	-	mW
Uniformity (with L/G)	- I _f =15mA 80%*1					
Bare LED Luminous intensity	$ \begin{array}{ c c c c c } V_f & 10V & 2400 & - & - & cd/m^2 \\ I_f & 15mA & 2400 & - & - & cd/m^2 \\ \end{array} $					cd/m ²
Luminous color	White					
Chip connection		3 ch	nip serial c	onnection		

Bare LED measure position:



*1 Uniformity (LT): $\frac{Min(P1 \sim P9)}{Max(P1 \sim P9)} \times 100 \ge 80\%$

4-3 Touch Panel Electrical Specification

Parameter	Condition	Standard Value	
Terminal Desistance	X Axis	140 ~ 640 Ω	
Terminal Resistance	Y Axis	180 ~ 900 Ω	
Insulating Resistance	DC 25 V	More than $20M\Omega$	
Linearity		±1.5 %	
Notes life by Pen	Note a	100,000 times(min)	
Input life by finger	Note b	1,000,000 times (min)	

Note A .

Hitting pad : Tip R8 mm Silicone rudder, & Tip R0.8 mm stylus pen(POM). Hitting speed : 2 times / sec.

Electric load : None.

Note B.

Hitting pad : Tip R0.8 mm stylus pen(POM).

Sliding speed : 150mm / sec.

Sliding length : 25mm.

Electric load : None.

Pin	Symbol	Function			
1	XL	Touch Panel Left Signal in X Axis			
2	YU	Touch Panel Top Signal in Y Axis			
3	XR	Touch Panel Right Signal in X Axis			
4	YD	Touch Panel Bottom Signal in Y Axis			



5 Optical characteristics

Main LCD

5.1 Optical characteristics

(1/220 Duty in case except as specified elsewhere $Ta = 25^{\circ}C$)

LED	backlight	transmissive	module:
	Saoraight	anonio	modulo.

Item	Symbol	Temp.	Min.	Std.	Max.	Unit	Conditions
Response	Tr	25 °C	-	12		me	θ =0 °° , φ =0 °
time	Tf	25 °C	-	18		1115	(Note 2)
Contrast ratio	CR	25 °C		300	-	-	$\theta = 0^{\circ}, \phi = 0^{\circ}$ LED:ON, LIGHT:OFF (Note 4)
Transmittance	Т	25 °C	-	6.6	-	%	
Visual angle range front and rear	θ	25 °C		(∂f) 20 (∂b) 40		De- gree	φ = 0°, CR \ge 10 LED:ON LIGHT:OFF (Note 3)
Visual angle range left and right	θ	25 °C	(<i>θ</i> I) 45 (<i>θ</i> r) 45		De- gree	φ =90°, CR \ge 10 LED:ON LIGHT:OFF (Note 3)	
Visual angle direction priority				12:00			(Note 5)
Brightness				150		Cd/ m2	V _{LED} =10V, 15mA Full White pattern

5.2 CIE (x, y) chromaticity (1/220 Duty Ta = 25° C)

ltem	Symbol	Т	ransmissiv	Conditions	
	e y moor	Min. Typ. Ma		Max.	Conditionio
Red	Х	0.599	0.629	0.659	$\theta = 0^{\circ}, \varphi = 0^{\circ}$
Reu	Y	0.315	0.345	0.375	
Green	Х	0.318	0.348	0.378	$\theta = 0^{\circ}$, $\varphi = 0^{\circ}$
Oreen	Y	0.548	0.578	0.608	
Blue	Х	0.106	0.136	0.166	$\theta = 0^{\circ}$, $\varphi = 0^{\circ}$
Diue	Y	0.063	0.093	0.123	
\\/hite	Х	0.256	0.286	0.316	$\theta = 0^{\circ}$, $\varphi = 0^{\circ}$
VVIIILE	Y	0.278	0.308	0.338	



NOTE 1: Optical characteristic measurement system

NOTE 2: Response tome definition



NOTE 3: $\varphi \cdot \theta$ definition







Contrast Ratio : Cr=A/B

NOTE 5: Visual angle direction priority



6 Block Diagram

Block diagram (Main LCD)

Display format:A-Si TFT transmissive, Normally white type, 12 o'clock.Display composition:176 x RGB x 220 dotsLCD Driver :ILI9221Back light:White LED x 3 (ILED=15mA)



7 Interface specifications

Pin No.	Terminal	Functions
1	GND	GND-terminal for analog circuit.
2	VCI	Power supply for Step-up circuit. (VCi=2.5~3.3V)
3	VCC	Power supply for the internal logic circuit. (VCC=2.2~3.3V)
4	/CS	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed.
5	RS	The signal for register index or register command select . Low: Register index or internal status (in read operation); High: Register command.
6	/WR	Write clock terminal, active "L" (80 series interface).
7	/RD	Read clock terminal, active "L" (80 series interface).
8	DB0	
9	DB1	
10	DB2	MPU Interface for 8-bit twice 80-system input.
11	DB3	
12	DB4	
13	XL	Touch panel X axis
14	YD	Touch panel Y axis
15	DB5	
16	DB6	MPU interface for 8-bit twice 80-system input.
17	DB7	
18	RESET	LCD Reset terminal, active "L".
19	BL+	LED Back Light Positive
20	BL-	LED Back Light Negative
21	XR	Touch panel X axis
22	YU	Touch panel Y axis
23	GND	GND-terminal for analog circuit.
24	GND	GND-terminal for analog circuit.
25	GND	GND-terminal for analog circuit.

7.1 80-system 8-bit twice interface

In 80-system 8-bit bus parallel data transfer mode, the 16-bit bus instruction and GRAM write data are divided into lower and upper eight bits, and then the upper eight bits are transferred first. Furthermore, the GRAM write data can be expended into 16-bit bus automatically in internal process. Unused pin(DB9-0) must be fixed to the VDD or GND level.



Data format for 8-bit twice interface



7.2 Instruction List

Reg.							Upper	Code							Lower	Code			
No.	Register	R/W	RS	RB 15	RB 14	RB 13	RB 12	RB 11	RB 10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
IR	Index	W	0	*	*	*	*	*	*	*	*	*	ID6	ID5	ID4	ID3	ID2	ID1	ID0
SR	Status read	R	0	L7	L6	L5	L4	L3	L2	L1	L0	0	0	0	0	0	0	0	0
DOOP	Oscillation Start	W	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	OSC
RUUII	Device code read	R	1	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
R01h	Driver output control	W	1	0	VSPL	HSPL	DPL	EPL	SM	GS	SS	0	0	0	NL4	NL3	NL2	NL1	NL0
R02h	LCD AC driving Control	w	1	0	0	0	0	FLD1	FLD0	B/C	EOR	0	0	NW5	NW4	NW3	NW2	NW1	NW1
R03h	Entry Mode	w	1	TRI	DFM1	DFM0	BGR	0	0	0	0	0	0	I/D1	I/D0	AM	LG2	LG1	LG0
R04H	Compare Register (1)	w	1	0	0	CP11	CP10	CP9	CP8	CP7	CP6	0	0	CP5	CP4	CP3	CP2	CP1	CP0
R05h	Compare Register (2)	w	1	0	0	0	0	0	0	0	0	0	0	CP17	CP16	CP15	CP14	CP13	CP12
R07h	Display Control(1)	W	1	0	0	0	PT1	PT0	VLE2	VLE1	SPT	0	0	GON	DTE	CL	REV	D1	D0
R08h	Display Control(2)	w	1	0	0	0	0	FP3	FP2	FP1	FP0	0	0	0	0	BP3	BP2	BP1	BP0
R09h	Display Control(3)	W	1	0	0	0	0	0	0	0	0	0	0	PTG1	PTG0	ISC3	ISC2	ISC1	ISC0
R0Bh	Frame cycle control Adjustment Control	w	1	GD1	GD0	SDT1	SDT0	CE1	CE0	DIV1	DIV0	0	0	0	0	RTN3	RTN2	RTN1	RTN0
R0Ch	External Display Interface Control	w	1	0	0	0	0	0	0	0	RM	0	0	DM1	DM0	0	0	RIM1	RIM0
R10h	Power Control(1)	W	1	0	SAP2	SAP1	SAP0	0	BT2	BT1	BT0	0	AP2	AP1	AP0	0	DK	SLP	STB
R11h	Power Control(2)	W	1	0	0	0	0	0	DC12	DC11	DC10	0	DC02	DC01	DC00	0	VC2	VC1	VC0
R12h	Power Control(3)	W	1	0	0	0	0	0	0	0	0	0	0	0	PON	VRH3	VRH2	VRH1	VRH0
R13h	Power Control(4)	w	1	0	0	VCOMG	VDV4	VDV3	VDV2	VDV1	VDV0	0	0	0	VCM4	VCM3	VCM2	VCM1	VCM0
R21H	RAM Address Set	W	1	AD15	AD14	AD13	AD12	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
R22H	Write data to GRAM	w	1			v	Vrite Dat	a (Uppe	r)					V	Vrite Dat	a (Lowe	r)		
R23H	18-bit RAM Write Data Mask (1)	w	1	0	0	WM11	WM10	WM9	WM8	WM7	WM6	0	0	WM5	WM4	WM3	WM2	WM1	WM0
R24H	18-bit RAM Write Data Mask (2)	w	1	0	0	0	0	0	0	0	0	0	0	WM17	WM16	WM15	WM14	WM13	WM12
: Means the initial value is"1"						: Means the initial value is"0"													

Main LCD Driver IC:ILI9221

Reg.							Upper	Code							Lower	Code			
No.	Register	R/W	RS	RB 15	RB 14	RB 13	RB 12	RB 11	RB 10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
R30h	r Control (1)	w	1	0	0	0	0	0	MP12	MP11	MP10	0	0	0	0	0	MP02	MP01	MP00
R31h	r Control (2)	w	1	0	0	0	0	0	MP32	MP31	MP30	0	0	0	0	0	MP22	MP21	MP20
R32h	r Control (3)	w	1	0	0	0	0	0	MP52	MP51	MP50	0	0	0	0	0	MP42	MP41	MP40
R33h	r Control (4)	w	1	0	0	0	0	0	CP12	CP11	CP10	0	0	0	0	0	CP02	CP01	CP00
R34h	r Control (5)	w	1	0	0	0	0	0	MN12	MN11	MN10	0	0	0	0	0	MN02	MN01	MN00
R35h	r Control (6)	w	1	0	0	0	0	0	MN32	MN31	MN30	0	0	0	0	0	MN22	MN21	MN20
R36h	r Control (7)	w	1	0	0	0	0	0	MN52	MN51	MN50	0	0	0	0	0	MN42	MN41	MN40
R37h	r Control (8)	w	1	0	0	0	0	0	CN12	CN11	CN10	0	0	0	0	0	CN02	CN01	CN00
R38h	r Control (9)	w	1	0	0	0	OP14	OP13	OP12	OP11	OP10	0	0	0	0	OP03	OP02	OP01	OP00
R39h	r Control (10)	w	1	0	0	0	ON14	ON13	ON12	ON11	ON10	0	0	0	0	ON03	ON02	ON01	ON00
R40H	Gate Scan Control	w	1	0	0	0	0	0	0	0	0	0	0	0	SCN4	SCN3	SCN2	SCN1	SCN0
R41H	Vertical Scroll Control	w	1	0	0	0	0	0	0	0	0	VL7	VL6	VL5	VL4	VL3	VL2	VL1	VL0
R42H	First Screen Driving Position	w	1	SE17	SE16	SE15	SE14	SE13	SE12	SE11	SE10	SS17	SS16	SS15	SS14	SS13	SS12	SS11	SS10
R43H	Second Screen Driving Position	w	1	SE27	SE26	SE25	SE24	SE23	SE22	SE21	SE20	SS27	SS26	SS25	SS24	SS23	SS22	SS21	SS20
R44H	Horizontal RAM Address Position	w	1	HEA7	HEA6	HEA5	HEA4	HEA3	HEA2	HEA1	HEA0	HSA7	HSA6	HSA5	HSA4	HSA3	HSA2	HSA1	HSA0
R45H	Vertical RAM Address Position	w	1	VEA7	VEA6	VEA5	VEA4	VEA3	VEA2	VEA1	VEA0	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0
	: Means the initial value is"1"						: N	/leans	the i	nitial	value	is"0"							

8 Timing Characteristics 8.1Timing Characteristics

Read / Write Characteristics (8080-series MPU)

80-system Bus Timing Characteristics

< <normal mode<="" th="" write=""><th>(HWM=0).loVcc=1</th><th>.65V~3.3V</th><th>VCC=2.4~3.3V >></th></normal>	(HWM=0).loVcc=1	.65V~3.3V	VCC=2.4~3.3V >>
	(1100101 0),100000 1	.000 0.00 ,	VOO 2.4 0.0V / /

	Item		Symbol	Unit	Min	Тур	Max
Rue ovelo time		Write	tCYCW	ns	100	-	-
Bus cycle lifte	5	Read	tCYCR	ns	300	-	-
Write low-leve	l pulse width		PWLW	ns	50	-	500
Read low-leve	l pulse width		PWLR	ns	150	-	-
Write high-leve	PWHW	ns	50	-	-		
Read high-lev	el pulse width		PWHR	ns	150	-	-
Write/Read rise/fall time			tWRr,WRf	ns	-	-	25
Sot un timo	(RS to NCS,E	_NWR)	+A S	ns	10	-	T.B.D
Secuptime	(RS toNCS,RE	E_NRD)	IA3	ns	5	-	-
Address hold	time		tAH	ns	5	-	-
Write data set	up time		tDSW	ns	10	-	-
Write data hole	d time		tH	ns	15	-	-
Read data del	ay time		tDDR	tDDR ns 1			100
Read data hol	d time		tDHR	ns	5	-	-

Reset Timing Characteristics (VCC=1.8~3.3V, IOVCC=1.65~3.3V)

Item	Symbol	Unit	Min	Тур	Max
Reset"low"level width	tRES	ms	1	-	-
Reset rise time	trRES	us	-	-	10





80-System Bus Timing

9 SETUP FLOW OF POWER SUPPLY



Power Supply ON/OFF Sequence

10 INSTRUCTION SETUP FLOW





11 QUALITY AND RELIABILITY

11.1 TEST CONDITIONS

Tests should be conducted under the following conditions : Ambient temperature : $25 \pm 5^{\circ}C$ Humidity : $60 \pm 25\%$ RH.

11.2 SAMPLING PLAN

Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

11.3 ACCEPTABLE QUALITY LEVEL

A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

11.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under flourescent light. The inspection area of LCD panel shall be within the range of following limits.



11.5 INSPECTION QUALITY CRITERIA

No.	Item	Criterion fo	or defects	Defect type	
1	Non display	No non display is allowed		Major	
2	Irregular operation	No irregular operation is allow	wed	Major	
3	Short	No short are allowed	Major		
4	Open	Any segments or common are rejectable.	patterns that don't activate	Major	
5	Black/White spot (I)	Size D (mm)Acceptable number $D \le 0.15$ Ignore $0.15 < D \le 0.20$ 3 $0.20 < D \le 0.30$ 2 $0.30 < D$ 0		Minor	
6	Black/White line (I)	Length(mm)Width (mm) $10 < L$ $0.03 < W \le 0.0$ $5.0 < L \le 10$ $0.04 < W \le 0.0$ $1.0 < L \le 5.0$ $0.06 < W \le 0.0$ $L \le 1.0$ $0.07 < W \le 0.0$	Minor		
7	Det Defect	Bright dot Dark dot	$\begin{array}{c} N \leq 1 \\ N \leq 3 \end{array}$	Minor	
	Dot Delect	Total dot defect (Bright dot + Dark dot) Minimum distance between dark dot and dark dot	$N \le 3$ 0.1 <d<math>\le0.3mm,N≤ 2</d<math>	Minor	
8	Back Light	 No Lighting is rejectable Flickering and abnormal li 	ghting are rejectable	Major	
9	Display pattern	A + B ≤ 0.30 0 < C D Note: 1. Acceptable up to 3 dam 2. NG if there're to two or	$\frac{1}{2} + \frac{E}{2} \le 0.25$ $\frac{F+G}{2} \le 0.25$ hages more pinholes per dot	Minor	

10	Blemish & Foreign matters Size: $D = \frac{A+B}{2}$	Size D (m D ≤ 0.15 0.15 < D ≤ 0.20 0.20 < D ≤ 0.30 0.30 < D	nm)	Ac	ceptable number Ignore 3 2 0	Minor		
11	Scratch on Polarizer	Width (mm) W≤0.03 0.03 <w≤0.05< td=""> 0.05<w≤0.08< td=""> 0.08<w< td=""> Note(1) Regard a</w<></w≤0.08<></w≤0.05<>	Im) Length (n 0.03 Ignore 0.05 L < 2.0		Acceptable number Ignore Ignore 1 1 Ignore Note(1)	Minor		
12	Bubble in polarizer	Size D (m D ≤ 0.20 0.20 < D ≤ 0.50 0.50 < D ≤ 0.80 0.80 < D	nm)	Ac	ceptable number Ignore 3 2 0	Minor		
13	Stains on LCD panel surface	Stains that can with a soft cloth	Minor					
14	Rust in Bezel	Rust which is v	Minor					
15	Defect of land surface contact (poor soldering)	Evident crevice	Evident crevices which is visible are rejectable.					
16	Parts mounting	 Failure to mo Parts not in t Polarity, for e 	ount parts he specifi example, i	cations a s reverse	re mounted	Major Major Major		
17	Parts alignment	1. LSI, IC lead outline. 2. Chip compor the leads is	I width is nent is off off the pa	f center and outline	han 50% beyond pad and more than 50% of	Minor		
18	Conductive foreign matter (Solder ball, Solder chips)	1. 0.45< φ 2. 0.30< φ <u><</u> 0.49 φ :Average 3. 0.50 <l L: Average</l 	Major Minor Minor					
19	Faulty PCB correction	1. Due to PCB connected, places are o 2. Short circuite	Minor					
		been perfor						

11.6 RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=96 hrs	
Low Temperature Operation	-20±3°C , t=96 hrs	
High Temperature Storage	80±3°C , t=96 hrs	1,2
Low Temperature Storage	-30±3°C , t=96 hrs	1,2
Humidity Test	40°C , Humidity 90%, 96 hrs	1,2
Thermal Shock Test	-30°C ~ 25°C ~ 80°C 30 min. 5 min. 30 min. (1 cycle) Total 5 cycle	1,2
Vibration Test (Packing)	Sweep frequency : 10~55~10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2
Static Electricity	150pF 330 ohm <u>+</u> 8kV, 10times air discharge	

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions

(15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

12 USE PRECAUTIONS

12.1 Handling precautions

- 1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
- 2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
- 3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
- 4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

12.2 Installing precautions

- 1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. $1M\Omega$ and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
- 2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
- 3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
- 4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

12.3 Storage precautions

- Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
- 2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
- 3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

12.4 Operating precautions

- 1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
- 2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
- The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC dive voltage.
- 4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
- 5) Make certain that each signal noise level is within the standard (L level: 0.2Vdd or less and H level: 0.8Vdd or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
- 6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
- 7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that

they are shielded from light emissions.

8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

12.50ther

- 1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
- 2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.

13 MECHANIC DRAWING



Date : 2006/11/07

14 Packing condition

