

Toshiba Mobile Display

Liquid Crystal Display
PRODUCT INFORMATION

Diameter 18cm (7 inch) full color

TFT-LCD Monitor Module
LTA070B1P4F

This is a tentative document for studying a 7 inch LCD "LTA070B1P4F".
This product has been designed for car TV and TV monitor.

TENTATIVE

Revision History

CONFIDENTIAL

Rev.	Date	Description	Resp.
0	June 23, 2008	issued	H.Shigi
1	Oct 24. 2008	add characteristics	Y.Hosoi
2	June 12.2009	updated a company name.	

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2009-06-12 Rev 2

1. Scope

This specification is applicable to Toshiba Mobile Display's 262,144 colors TFT-LCD Module "LTA070B1P4F" designed for Car TV and TV monitor use.

2. Specifications

2.1 General Specifications

Items		Specifications	Note
Screen Size		18cm (7.0 inch) diagonal screen	Aspect ratio 15:9
Display Mode		TN full color (Transmissive type), Normally-White	
Construction		TFT-Cell, Drivers, Backlight (LED), Metal case	
Viewing Direction		12 o'clock (in direction of maximum CR)	Refer to Figure 1
Driving Mode		a-Si TFT active matrix, Line sequential scanning, Non-interlace drive	
Input signal	Power supply	4 supply voltage (+3.3V, +5.0V, +18.5V, -12V)	Refer to the timing chart
	Video Signal	Digital RGB signal (RGB x 6bit)	
	Sync.Signal	Clock (H/V), Start signal (H/V), Enable (H/V)	
	Others	Display inversion control (H/V), gradational standard voltage, Vcom signal	
Number of Pixels		800(W) X 480(H)	
Number of Sub-Pixels		2400(W) X 480(H)	
Pixel Pitch		0.1905(W) X 0.1905(H)	Unit : mm
Pixel Arrangement		RGB stripe	Refer to Figure 2
Outline Dimension		170.0(W) X 104.0(H) X 8.0 (D)	Unit : mm
Surface Treatment		Anti-glare, Wide viewing film	
Weight		210 (typ)	Unit : g
Environment		This product conforms to RoHS Directive.	

Figure 1: Viewing Direction

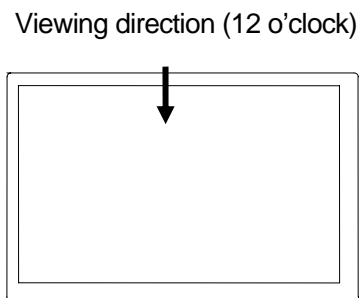
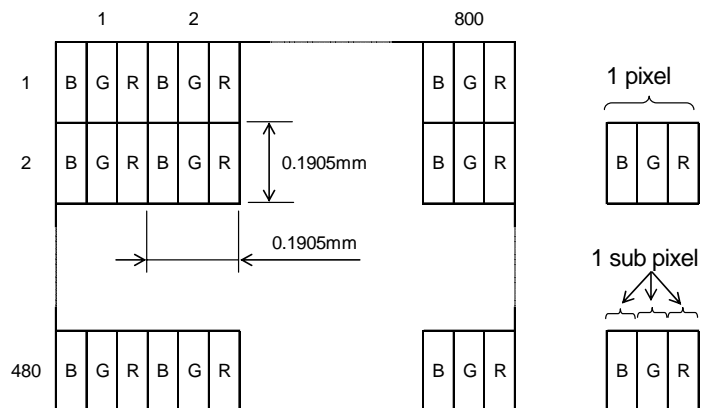


Figure 2: Pixel Arrangement



2.2 Absolute Maximum Ratings

Item		Symbol	Condition	Absolute maximum ratings (Note1)		Unit
				Min.	Max.	
Supply voltage	Logic	DVDD	Ta=25 ± 5 GND=0V	- 0.3	+ 4.0	V
	Video	AVDD		- 0.3	+ 6.0	V
	Gate Hi	VGH		+15.0	+42.0	V
	Gate Lo	VGL		-20.0	+ 0.3	V
		VGH-VGL		20	40	V
Input signal	Logic	Note 2		-0.2	DVDD+0.3	V
	Data	Note 3		-0.3	DVDD+0.3	V
	Gradational potential	Note 4		-0.3	AVDD-0.3	V
	Common Voltage	V _{com}		-	13.0	Vp-p
Backlight LED current (Forward)		Irms		-	150	mA
Operating temp.		Top	Note 56	-30	+85	
Storage temp.		Tstg	Note 5	-40	+85	

Note 1: No value of the absolute maximum rating is allowed to exceed. When the item is used at exceeded value, some property may not recover, and may also be destroyed permanently in case of going far beyond. For this reason, please take account of fluctuation of supply voltage, characteristics of connected parts, surge of input/output signal, and ambient temperature when designing circuit and mechanism.

Note 2: The object signals are CPH, CPV, STH1, STH2, STV1, STV2, OE, STB, ALON, U/D, L/R.

Note 3: The object signals are R0 to R5, G0 to G5, B0 to B5.

Note 4: The object signals are V0 to V10.

Note 5: The temperature is defined as surface temperature on the LCD.

Note 6: The temperature of this product rises during operation by heat generated by the backlight.

For this reason, please design so that the temperature of touchable surface should not exceed +85 .

2.3 Mechanical Specifications

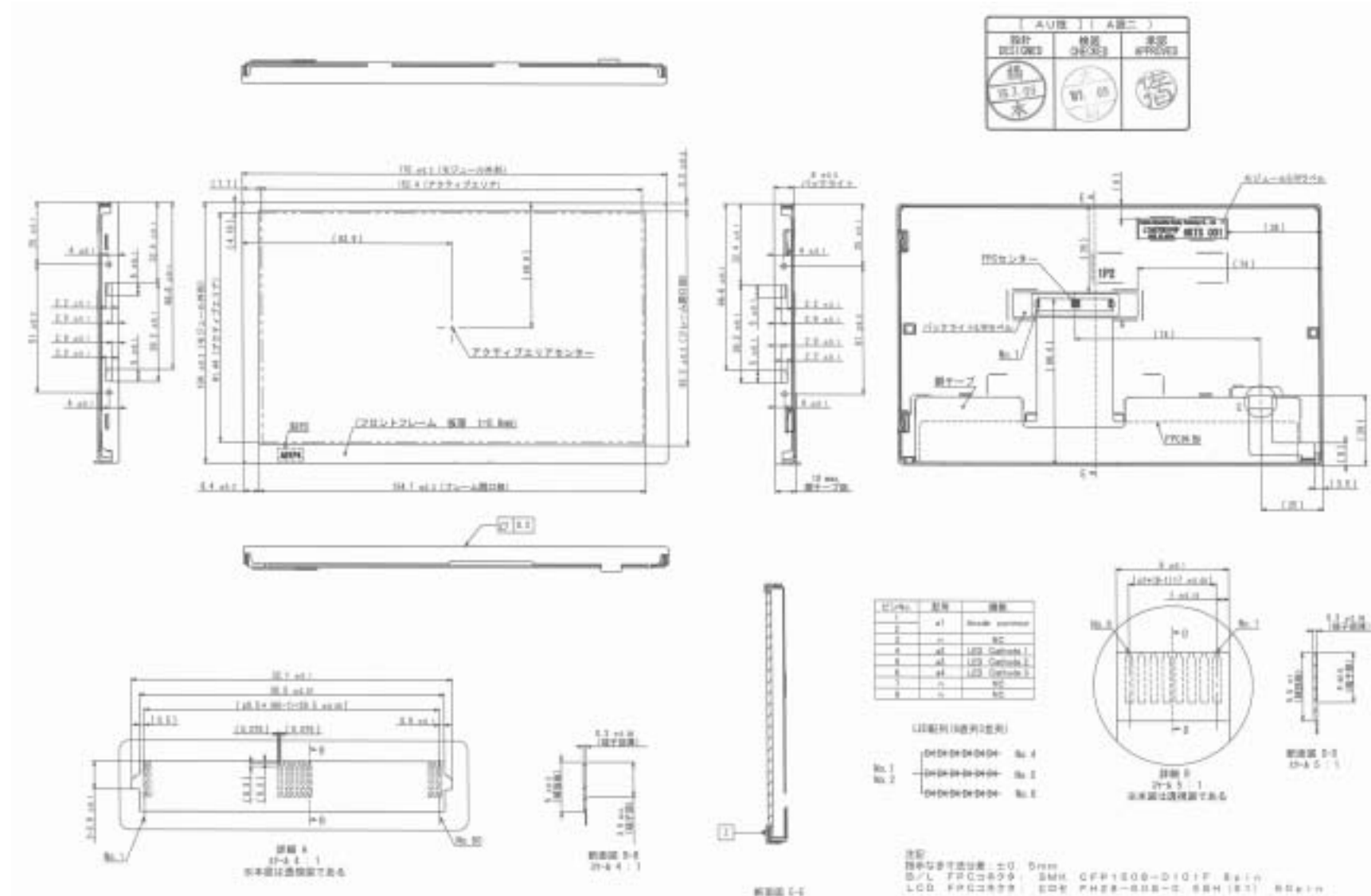
2.3.1 Outline dimension

Items	Specification	Unit	Note
Outline	170.0(W) (Typ) X 104.0(H) (Typ) X 8.0(D)	mm	Typ.
Active Area	152.4(W) X 91.44(H)	mm	
Display Area	153.8(W) X 92.84(H)	mm	Note 1

Note 1: The "Display area" is 0.7mm larger area than the active area on each side.

Note 2: Please refer to "Outline Dimension" on the next page for details.

Outline Dimension



2.3.2 Interface

CN1: For the LCD signals, 60pin - 0.5 mm pitch, gold-plating

Mating connector: Hirose/ FH28-60S-0.5SH (0.5) or equivalent

Note 5,6

Pin No.	Symbol	Function	I/O	Note	Pin No.	Symbol	Function	I/O	Note
1	VCOM	Common electrode signal	I		31	B 4	B data 4	I	
2	VCOM	Common electrode signal	I		32	B 3	B data 3	I	
3	NC	Open	-		33	B 2	B data 2	I	
4	STV1	Vertical start pulse 1	O (I)	4	34	B 1	B data 1	I	
5	NC	Open	-		35	B 0	B data 0 (LSB)	I	
6	VGH	Gate positive power supply voltage +18.5V	I	1	36	G5	G data 5 (MSB)	I	
7	NC	Open	-		37	G4	G data 4	I	
8	VGL	Gate negative power supply voltage -12.0V	I	1	38	G3	G data 3	I	
9	NC	Open	-		39	G2	G data 2	I	
10	ALON	Connecting to DVDD(+3.3V)	I		40	G1	G data 1	I	
11	NC	Open	-		41	G0	G data 0 (LSB)	I	
12	GND	Ground 0V	-		42	R5	R data 5 (MSB)	I	
13	GND	Ground 0V	-		43	R4	R data 4	I	
14	CPV	Vertical (gate driver) clock	I		44	R3	R data 3	I	
15	OE	Gate off signal	I		45	R2	R data 2	I	
16	U/D	Vertical scanning switch	I	4,6	46	R1	R data 1	I	
17	STV2	Vertical start pulse 2	I(O)	4,6	47	R0	R data 0 (LSB)	I	
18	GND	Ground 0V	-		48	V10	Gradational voltage 10	I	
19	GND	Ground 0V	-		49	V9	Gradational voltage 9	I	
20	GND	Ground 0V	-		50	V8	Gradational voltage 8	I	
21	STH2	Horizontal start pulse 2	I(O)	3,6	51	V7	Gradational voltage 7	I	
22	D V D D	Digital power supply voltage +3.3V	I	1	52	V6	Gradational voltage 6	I	
23	C P H	Horizontal (source driver) clock	I		53	V5	Gradational voltage 5	I	
24	G N D	Ground 0V	-		54	V4	Gradational voltage 4	I	
25	G N D	Ground 0V	-		55	V3	Gradational voltage 3	I	
26	A V D D	Analog power supply voltage +5.0V	I	1	56	V2	Gradational voltage 2	I	
27	A V D D	Analog power supply voltage +5.0V	I	1	57	V1	Gradational voltage 1	I	
28	L/R	Horizontal scanning switch	I	3	58	V0	Gradational voltage 0	I	
29	STB	Strobe input	I		59	STH1	Horizontal start pulse 1	O (I)	3,6
30	B 5	B data 5 (MSB)	I		60	G N D	Ground 0V	-	

CN2: For the backlight, 8 pin – 0.5mm pitch

Mating connector: SMK/ CFP1508-0101F

Pin No.	Symbol	Function
1	a1	Anode (Common)
2	a1	Anode (Common)
3	NC	Open
4	c1	LED cathode 1
5	c2	LED cathode 2
6	c3	LED cathode 3
7	NC	Open
8	NC	Open

Toshiba Mobile Display Co.,Ltd.

Date : 2009-06-12 New PI-LTA070B1P4F-02

Date : 2008-10-24 Old No. PI-LTA070B1P4F

Input equivalent circuit

symbol	equivalent circuit
<p><u>TYPE-A</u></p> <p>R0-5 G0-5 B0-5 STB L/R CPH CPV U/D</p>	
<p><u>TYPE-B</u></p> <p>V0-V10</p>	
<p><u>TYPE-C</u></p> <p>STH1 STH2</p>	
<p><u>TYPE-D</u></p> <p>STV1 STV2</p>	
<p><u>TYPE-E</u></p> <p>ALON</p>	
<p><u>TYPE-F</u></p> <p>VCOM</p>	
<p><u>TYPE-G</u></p> <p>DVDD AVDD VGH VGL</p>	

Note1: Please follow below for the power supply and sequence;

Sequence

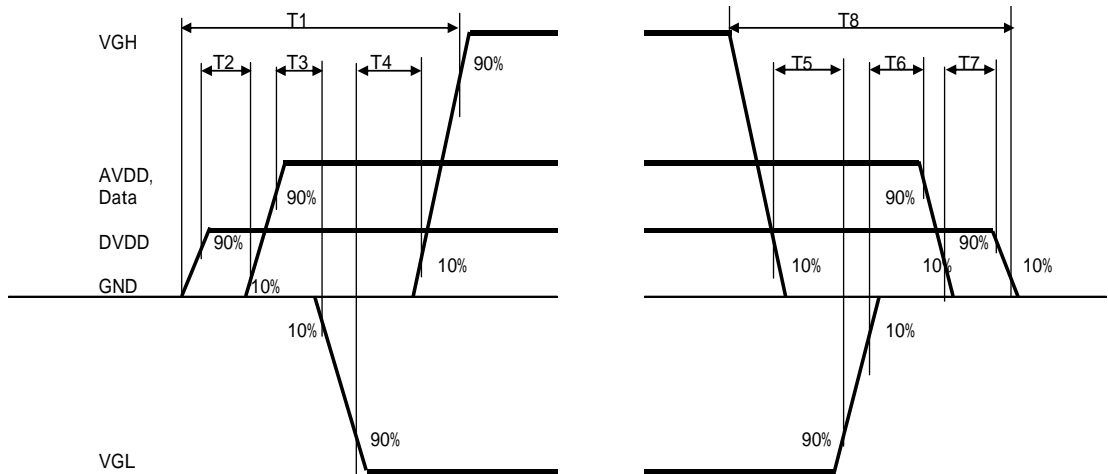
ON: DVDD(+3.3V) → AVDD(+5.0V) → VGL(-12.0V) → VGH(+18.5V)

OFF: VGH(+18.5V) → VGL(-12.0V) → AVDD(+3.3V) → DVDD(+3.3V)

Please input ON (≥ 90% of potential) or OFF (≤ 10% of potential) to the items of the power supply voltage in above order. All items shall be set at ON or OFF within 60ms.

Please contact us if there is a difficulty to follow the sequence.

No item is allowed to be set at ON or OFF individually.



T1, T8 < 60ms

T2,T3,T4,T5,T6,T7 > 0ms

The voltage level of VGL and VGH shall be observed.

Note 2: Please input H inversion power supply for standard gradational voltage according to the circuit example.

Note 3: The direction of horizontal scanning can be selected as below.

	No.28 L/R	No.59 STH1	No.21 STH2
Normal (L to R)	Hi (3.3V)	Input	Output
Reverse (R to L)	Lo (0V)	Output	Input

Note 4: The direction of vertical scanning can be selected as below.

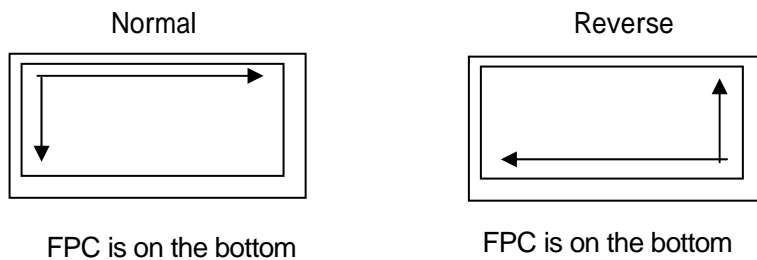
	No.16 U/D	No.4 STV1	No.17 STV2
Normal (U to D)	Lo (0V)	Input	Output
Reverse (D to U)	Hi (3.3V)	Output	Input

Note 5: Please refer to specification of circuit example, electrical characteristic and timing for signal specification.

Note 6: The relation between display data and gray scale level is shown in the following table.

	Gray scale Level	R5 G5 B5 (MSB)	R4 G4 B4	R3 G3 B3	R2 G2 B2	R1 G1 B1	R0 G0 B0 (LSB)
Black	L0	Lo	Lo	Lo	Lo	Lo	Lo
:	L1	Lo	Lo	Lo	Lo	Lo	Hi
:	L2	Lo	Lo	Lo	Lo	Hi	Lo
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
:	L61	Hi	Hi	Hi	Hi	Lo	Hi
:	L62	Hi	Hi	Hi	Hi	Hi	Lo
White	L63	Hi	Hi	Hi	Hi	Hi	Hi

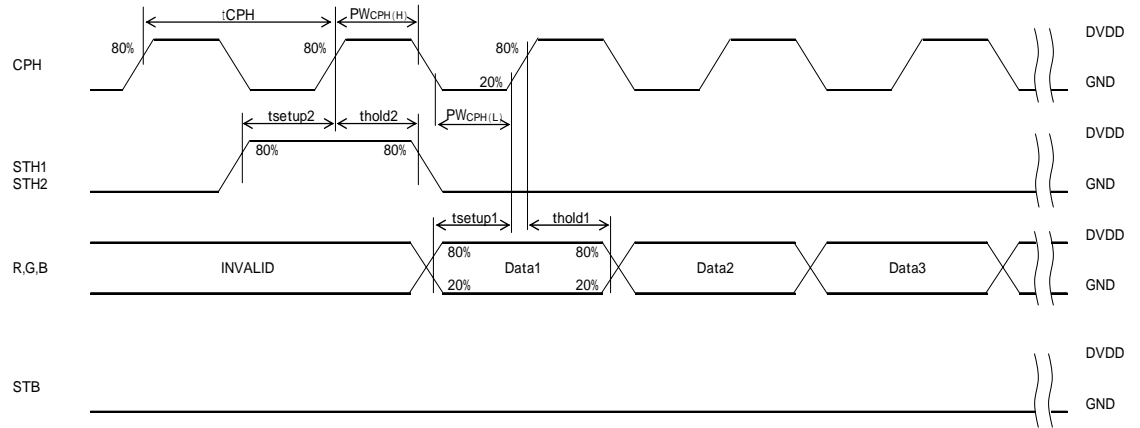
Note 7: The Normal / Reverse scanning directions;



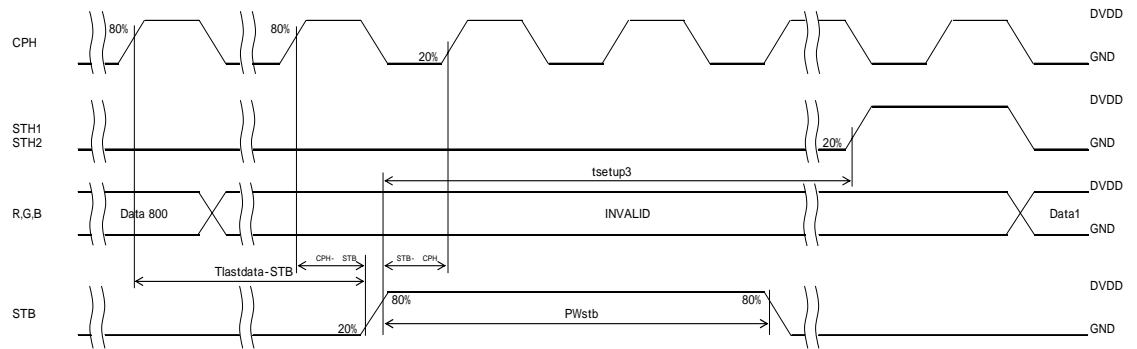
2.4.2 Timing Diagram

1) LCD input timing signal

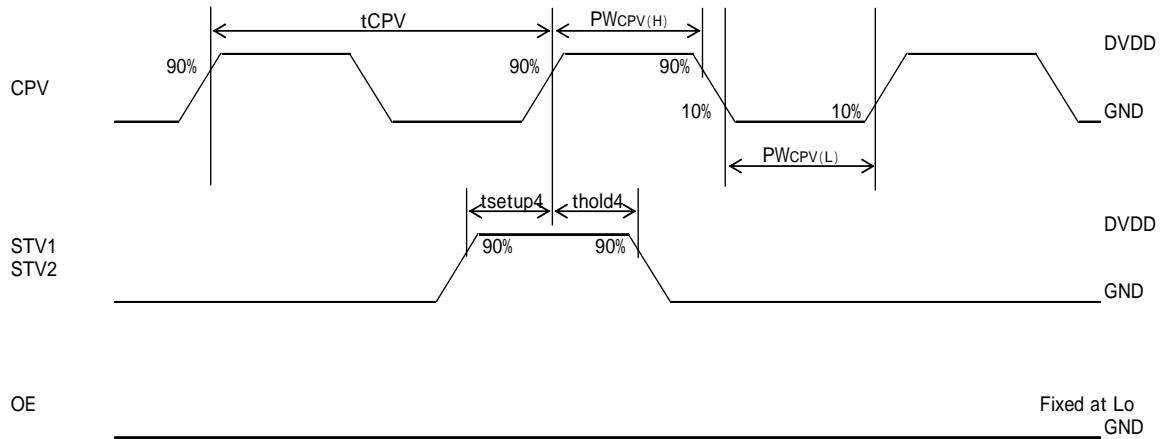
Horizontal



The continuation of the above diagram

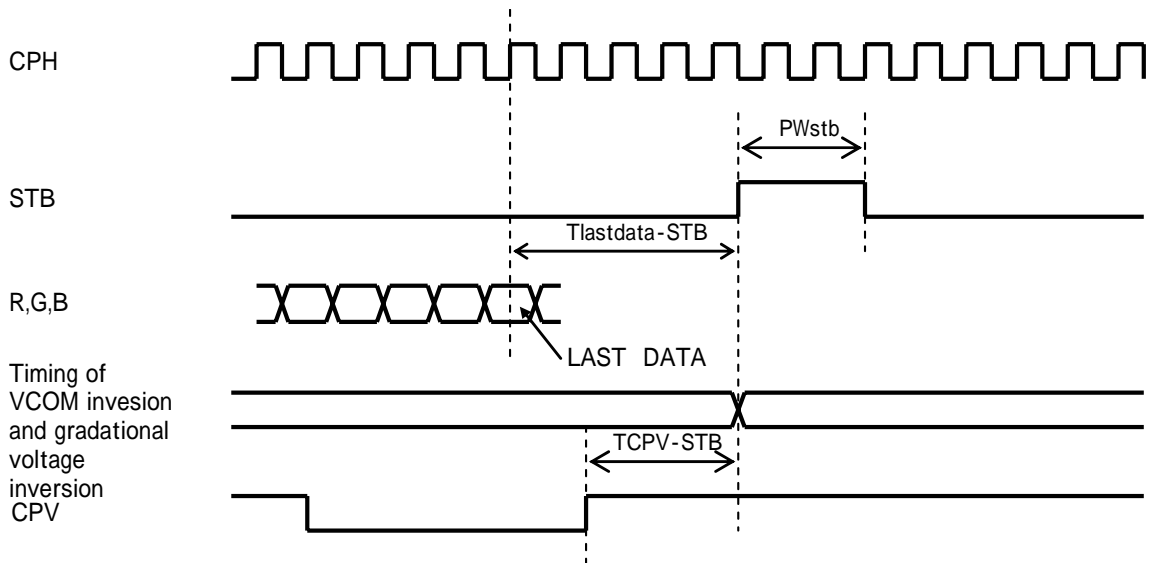


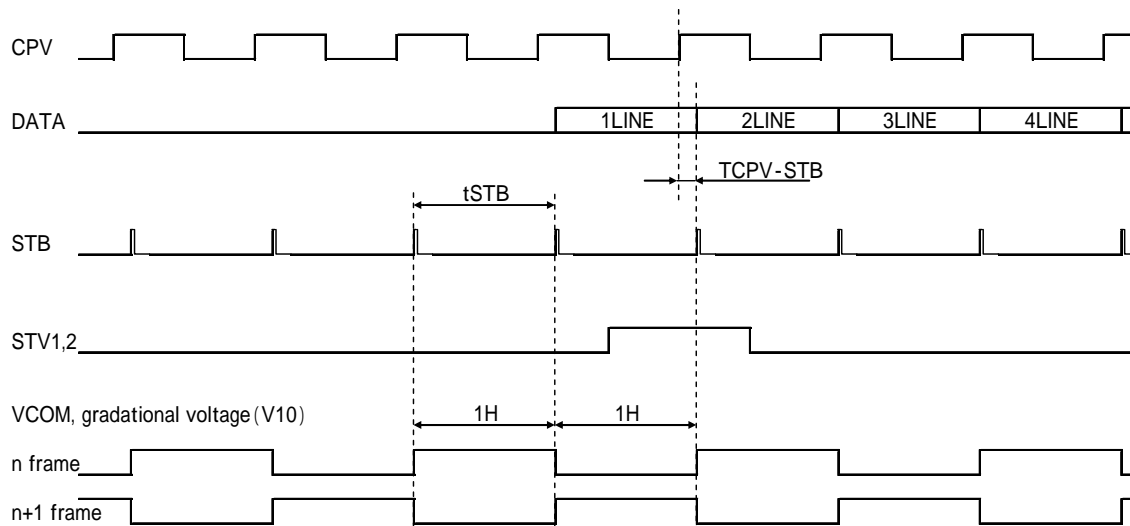
Vertical



Note: When power activation, please maintain OE at Hi for at least 2V period (Vertical scanning time) after CPV and STV are outputted.

A relation of timing among horizontal signal, Vertical signal, Vcom, gradational voltage inversion



Vertical display position and polarity of Vcom and gradational voltage (V10)

2) LCD input timing conditions

	Item	Symbol	Min.	Typ.	Max.	Unit
Horizontal (Source)	CPH frequency	$1/t_{CPH}$	-	33.2	40	MHz
	CPH Hi-time	PWCPH(H)	8	15	-	ns
	CPH Lo-time	PWCPH(L)	8	15	-	ns
	STH setup	tsetup2	6	15	-	ns
	STH hold	thold2	2	15	-	ns
	Data setup	tsetup1	6	15	-	ns
	Data hold	thold1	2	15	-	ns
	STB frequency	$1/r_{STB}$	-	31.5	33.3	kHz
	Final data timing	Tlastdata-STB	2	5	-	CLK (tCPH)
	STB pulse width	PWstb	2	3	-	CLK (tCPH)
	STB setup	tsetup3	2	250	-	CLK (tCPH)
	Time between CPH and STB	Between rising edge of CPH and STB	8	15	-	ns
Time between STB and CPH	Between rising edge of STB and CPH	8	15	-	ns	
Vertical (Gate)	CPV frequency	$1/t_{CPV}$	-	31.5	33.3	kHz
	1H term	tCPV	30	31.8	-	μ s
	CPV Hi-time	PWCPV(H)	6	15.9	-	μ s
	CPV Lo-time	PWCPV(L)	6	15.9	-	μ s
	STV setup	tsetup4	3	15.9	-	μ s
	STV hold	thold4	3	15.9	-	μ s
V/H	CPV-STB timing	TCPV-STB	2.5	3	3.5	μ s

3. Recommended Operating Conditions

($T_s=RT$)

Item	Symbol	Condition	Standard value (Note1)			Unit	note
			Min.	Typ.	Max.		
Supply voltage	DVDD		+ 3.0	+ 3.3	+3.6	V	
	AVDD		+4.5	+5.0	+5.5	V	
	VGH		+18.0	+18.5	+19.0	V	
	VGL		-12.5	-12.0	-11.5	V	
Permissible ripple voltage	VRP	Each power supply	-	-	(100)	mV(p-p)	
Input signal voltage (gate)	V _{IHG}	Hi level	0.9DVDD	-	DVDD	V	2
	V _{ILG}	Lo level	0	-	0.1DVDD	V	
Input signal voltage (source)	V _{IHS}	Hi level	0.8DVDD	-	DVDD	V	
	V _{ILS}	Lo level	0	-	0.2DVDD	V	
Input signal timing			Refer to Timing specification				3
Vcom signal	VCOM-AC	Bright arrangement	2.8	5.8	7	V(p-p)	4
	VCOM-DC	Flicker arrangement	-	(1.5)	-	V	4
Gray scale potential	V0 to V10	AVDD=5V	0.1	-	AVDD-0.1	V	5

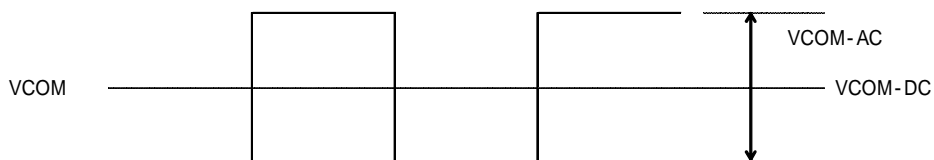
Number of LED	18
Number of parallel LED	3
Recommended operation current (TYP)	80mA
Recommended operation current (MAX)	85mA
LED VF (-30)	22.86V
LED VF (25)	19.26V
LED VF (80)	14.76V
Total VF value difference between parallels	1.4V

Note 1: The recommended operating conditions show the range of guaranteed performance of this product.

Note 2: The object signals are CPH, CPV, STH1, STH2, STV1, STV2, OE, STB, ALON, U/D, L/R

Note 3: Please refer to the electrical characteristic and the timing specification for the timing of input signal.

Note 4: Vcom signal is showed in the following diagram. The amplitude is variable with BRT terminal when connecting to recommended circuit (Usually TYP value is used). Please adjust the center voltage to lead minimum flicker. The above table shows the referent values.



Note 5: Please adjust the gradational voltage so as to satisfy the followings;

$$0.1V < V_{10} \leq V_9 \leq V_8 \leq V_7 \leq V_6 \leq V_5 \leq V_4 \leq V_3 \leq V_2 \leq V_1 \leq V_0 < AVDD-0.1V \text{ or}$$

$$0.1V < V_0 \leq V_1 \leq V_2 \leq V_3 \leq V_4 \leq V_5 \leq V_6 \leq V_7 \leq V_8 \leq V_9 \leq V_{10} < AVDD-0.1V$$

Optical specifications

Optical characteristics (method is referred to 4. Measuring Method)

Common test conditions : $T_a=25 \pm 5^\circ\text{C}$, $\text{RH}=65 \pm 5\%$, $V_{\text{DD1}}=3.3\text{V}$, $V_{\text{DD2}}=5.0\text{V}$, $V_{\text{GH}}=18.5\text{V}$, $V_{\text{GL}}=-12.0\text{V}$,
 $V_{\text{SS}}=0\text{V}$, BL Driver : TMD standard (80mA/Chip)
 V_{com} C=Optimal value (flicker minimize), Measured after 30 minutes operation.

ITEM	SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	REMARKS
			MIN.	TYP.	MAX.		
RESPONSE TIME	t_{ON}	Data=L63→L0	-	15	25	ms	
	t_{OFF}	Data=L0→L63	-	20	40		
CONTRAST RATIO	CR	Data=L63/L0	150	250	-	-	Note1,2
VIEWING ANGLE	L/R	Data=L63/L0 CR≥10	45/45	55/55	-	deg	Note 5
	U/D		30/15	60/30	-		
LUMINANCE	L	Data=L63	320	(520)	-	cd/m2	Note 2,4
WHITE CHROMATICITY (Reference)	x	Data=L63	(0.265)	(0.315)	(0.365)	-	Note 4
	y		(0.275)	(0.325)	(0.375)		
UNIFORMITY	DLUM	Data=L63	70	-	-	%	Note 4
BACKLIGHT LIFE (Reference)	-	continuous	(10000)	-	-	h	Note 3

Note 1:100% brightness.

Note 2:These values vary with brightness input.

Note 3:MTTF(Mean Time to Failure), time to become 50% brightness.

Note 4:This spec is spectroradiometer [BM-7] of TMD's Himeji factory.

Note 5:The viewing direction of this product is 12 o'clock(up side). It is in direction of maximum CR,
and shows darker tint.

Thermal dependance

Items	Specifications		Remarks
	$T_a=0^\circ\text{C}$ Note 1	$T_a=60^\circ\text{C}$ Note 1	
Luminance		$L \geq 150\text{cd/m}^2$	
Contrast ratio		$CR \geq 100$	
Response time	t_{ON}	$T_{\text{ON}} \leq 200\text{ms}$	$t_{\text{ON}} \leq 10\text{ms}$
	t_{OFF}	$t_{\text{ON}} \leq 250\text{ms}$	$t_{\text{ON}} \leq 20\text{ms}$
Screen quality	No conspicuous unevenness and display defect. No disorder for the synchronous signal (and synchronous of color).		

Note 1 : The temperature on TFT-LCD panel surface.

Display quality

Display quality (Room temperature)

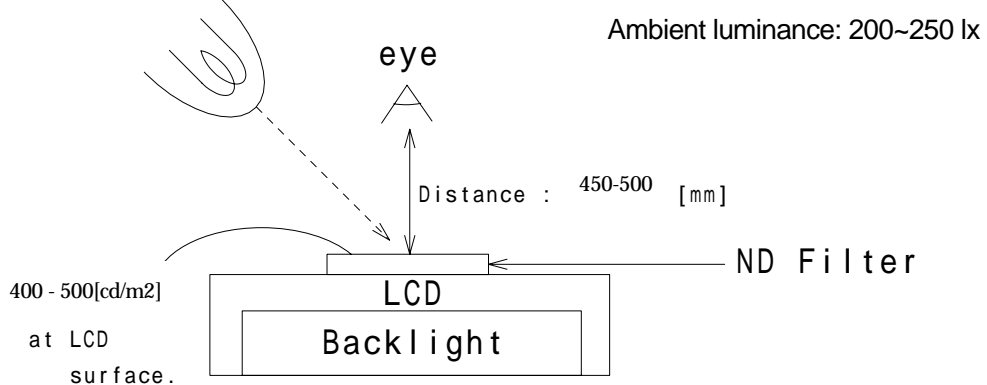
Common test conditions : $T_a=25 \pm 5^\circ\text{C}$, $\text{RH}=65 \pm 5\%$, $V_{DD1}=3.3\text{V}$, $V_{DD2}=5.0\text{V}$, $V_{GH}=18.5\text{V}$, $V_{GL}= -12.0\text{V}$,
 $V_{SS}=0\text{V}$, BL Driver : TMD standard (80mA/Chip)
 V_{com} C=Optimal value (flicker minimize), Measured after 30 minutes operation.

Items		Definition	Standards
Display defect	Line	Black, white, color line. Horizontal or vertical line missing.	No defect
	Dot	Count sub-pixel light-produced unevenness caused by TFT and CF as dot defect 1)Bright dot Pixel that is visible through specified ND(Neutral density) filter under specified conditions at black signal (Data=L0) input 2)Dark sub-pixel Pixel that is darker than 50% of maximum luminance at white signal (Data=L63) input	Note 1
Screen quality	Smear	Spot defect whose luminance isn't uniform.	Note 2 (next sheet)
	Unevenness	Partial luminance or chromatic non-uniformity.	
	Non-uniformity streak	Streak shaped luminance or chromatic non-uniformity.	
	Reverse	Concentrated unevenness (sub-pixel unit).	
	Others	Trash between LCD and backlight. ,etc.	

Note 1 : Sub-pixel defect specifications

Inspection condition of sub-pixel defects

Observation time : 5 [sec.]



Caution and Handling Precaution

For your end users' safety, it is strongly advised that the items with "*" should be included in the instruction manual of the system which may be issued by your organization.

Toshiba Mobile Display always endeavors to maintain sufficient quality in process of designing and manufacturing. However, to avoid causing extended damages such as accidents resulting in injury or death, fire, or social damages if the LCD module fails, take into consideration safe design such as redundant design, fire-spreading prevention design, over-current prevention design, or malfunction prevention design etc. as a whole set.

For Safety

Warning



The following warning indicates a potentially hazardous situation which could result in death or serious injury if you do not follow instructions.

1) SPECIAL PURPOSES

Toshiba Mobile Display's Standard LCD modules described in this Specification are not customized for applying to equipments (for example: nuclear control systems, airplanes and space vehicles, combustion control systems, various safeguards, medical equipment etc.) of which failures or malfunctions may directly threaten a human life or hurt a human body. When using them for the above equipments, consult with our company beforehand.

Understand that our company cannot take responsibility for the damage etc. occurred by use without consultation.

Caution



The following caution indicates a potentially hazardous situation which may result in minor injury or moderate injury, with incorrect usage.

*1) DISASSEMBLING OR MODIFICATION

DO NOT DISASSEMBLE OR MODIFY the modules. Disassembling the module may result in an electric shock.

Sensitive parts inside LCD module may be damaged, and dusts or scratches may cause fire or breakage of circuits or parts or surface damage of display. Toshiba Mobile Display does not warrant the modules, if customer disassembled or modified them.

*2) BREAKAGE OF LCD PANEL

DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT PERMIT this material to contact the skin, if glass of LCD panel is broken.

If liquid crystal material contacts the skin, mouth or clothing, take the following actions immediately.

In case contact to the eye or mouth, rinse with large amount of running water for more than 15 minutes. In case contact to the skin or clothing, wipe it off immediately and wash with soap and large amount of running water for more than 15 minutes. The skin or clothing may be damaged if liquid crystal material is left adhered.

In case ingestion, rinse out the mouth well with water. After spewing up by drinking large amount of water, get medical treatment.

*3) GLASS OF LCD PANEL

BE CAREFUL WITH CHIPS OF GLASS that may cause injuring fingers or skin, when the glass is broken.

The LCD module has the structure where a plastic film is stuck on a glass surface and glass cannot disperse easily. However, touching a cut surface may cause injuries.

4) ABSOLUTE MAXIMUM RATINGS

DO NOT EXCEED the absolute maximum ratings specified in this Specification. These are the rated values that must not exceed for a LCD module by any means. Since the parts used as a circuit are damaged by fire or breakage and the characteristic may not be recovered when exceeding this rating, take into consideration the variation in ambient temperature, input signal change, and dispersed specification of electric parts etc., and design not to exceed LCD module absolute maximum ratings.

5) POWER PROTECTION CIRCUIT

Employ protection circuit for power supply, for LCD module failures according to the operating condition of a set.

A suitable protection circuit should be applied, based on each system design.

A fuse is not fitted to this module. Therefore, without a suitable power-supply protection device, dust or partial circuit failure may cause overheating and/or fire, which may lead to injury.

6) DISPOSAL

Always comply with all applicable environmental regulations, when discarding the LCD module.

7) EDGES OF PARTS

Be careful with handling the metal frame (bezel) of a LCD module. Even though deburring treatment is performed, it may cause injury. Be careful with edges of glass parts and identically. For designing the system, give special consideration that the wiring and parts do not touch those edges.

8) RECOMMENDED OPERATING CONDITIONS

Don't exceed "the recommended operation conditions" in this specification. (The LCD module should be used within "the recommended operation conditions".)

The performance and quality of the LCD module are warranted only when the LCD module is used within "the recommended operation conditions". Toshiba Mobile Display never warrants the performance and quality of the LCD module when you use the LCD module over "the recommended operation conditions", although within "the absolute maximum rating".

To use the LCD module over "the recommended operation conditions" may have bad influence on the characteristics and reliability of the LCD module and may shorten the life of the LCD module.

Therefore, when designing the whole set, not to be over "the recommended operation conditions", you should fully take care of supply voltage change, characteristic of connection parts, surge of input-and-output line, and surrounding temperature.

***9) HIGH TEMPERATURE ON LED**

LED(s) that become a backlight source is/are built into a LCD module.

Please mind that the portion such as the surface of LCD module, the metal frame portion, and LED unit cover on the rear side become high temperature during lighting and right after turning off the LED.

In the case you have to contact these portions, surely turn off the power supply of the LCD module first, and being careful with ESD prevention, use hand glove that protects hands (skin) from heat or contact after the temperature at the metal portion falls to the room temperature level.

For Designing the System**1) MOUNTING HOLES**

Use all the mounting holes described in this Specification when assembling a LCD module in a set. Use screws with a proper size described in this Specification.

***2) TWIST/WARP**

When assembling a LCD module in a set and using the set, be careful not to apply stress, such as twist or warp, on the LCD module at designing an enclosure of the set. Twist or warp may cause LCD module failures.

Toshiba Mobile Display Co.,Ltd.

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←# Special ←& Addition ← Change

3) DESIGN ON THE REAR OF A LCD MODULE

Design a set so that the LCD module rear is not pressed by a set enclosure or a cable, etc.

Pressing the LCD module rear deforms a panel etc. and may cause non-uniformity in a display. Applying stress on a light guide plate causes white spot and black spot. Since applying stress on a circuit board may cause damage, do not touch it.

Make sure no white spot and black spot is in a display in case rear cover is pressed by ground connecting to prevent radiation etc.

4) GAS GENERATED FROM THE PART MATERIAL FOR A SET

Some plastic materials and shock absorbing materials (rubber) used in the system may generate gases that may cause the deterioration of the polarizer laminated on LCD's panel or internal parts of the LCD module. Prior confirmation is required.

5) GAS GENERATED FROM CASING /PACKAGING MATERIAL FOR A SET

Some materials used for packaging (for which sulfuric acid is used in the recycling process) generate gases that may cause the deterioration of the polarizer laminated on LCD's panel or internal parts of the LCD module. Prior confirmation is required.

6) CAPACITY OF POWER SUPPLY

Since no protection part such as fuse is equipped in this LCD module, please equip the set with the suitable protection circuit for accident prevention. And please choose the appropriate power supply.

Power Supply	Recommended maximum output current of power supply
DVDD	0.5A (max)
AVDD	1.0A (max)
V _{GH}	0.5A (max)
V _{GL}	0.5A (max)

7) SEQUENCE OF POWER SUPPLIES AND INPUT SIGNALS

Power-supply lines should be designed as follows.

Power supplies should always be turned on before the input signals are supplied to LCD module, and the input signals should be disconnected before power supplies are turned off.

If this sequence is not followed, it may cause mis-operation of the panel.

Refer to "Sequence of Power Supplies and Signals" described in this Specification for details.

In addition, refer to individual specifications for unused terminals.

8) IMAGE STICKING IN A DISPLAY

Design the system not to display the same pattern for a long time, and confirm no "after image" remains in a display.

Continuing the same pattern display for a long time or inputting the signals besides recommendation may cause the phenomenon "after image" which remains vaguely after changing patterns.

9) GROUNDING OF METAL FRAME(BEZEL)

Grounding of metal frame of LCD module is generally effective to prevent radiation interference from the system design. However, since there is a difference on set structures, judge totally whether finally to ground or not on the whole set.

10) PANEL ANGLE

Visibility of LCD module deeply depends on the viewing directions. The position and the angle of LCD module in the system should be designed so that the best visibility can be obtained at the actual usage.

11) WINDOW OPENING

Dimensions of window opening of the system's enclosure should be designed as smaller than "Viewing Area" and larger than "Active Area" specified in individual specification in order to prevent that a part of screen is interrupted by the enclosure and disappears.

12) PROTECTIVE COVER/ ULTRA-VIOLET CUT FILTER

In case of severe environmental condition like outdoor usage, a proper transparent protective cover (lens) over LCD module is recommended, to prevent scratches, invasion of dust and water, etc, between the system housing and the LCD module.

It is recommended to apply an ultra-violet filter (less than 390nm cut) onto the LCD module, for outdoor operation.

Strong ultra-violet radiation may damage the panel. However, in that case, transmittance-luminance will decrease. Careful selection of material is required.

Don't expose any parts, except the viewing area, into the direct sunlight, otherwise deterioration may occur.

For Installation in Assembly

1) CARRYING

Hold a metal frame (bezel) part with both hands when carrying a LCD module with hand. Holding FPC may cause failures, in the worst case, it may cause smoke and/or fire.

2) CAUTIONS TO PREVENT FROM ELECTROSTATIC DESTRUCTION UNDER ASSEMBLY WORK

Consider the following to prevent the static electricity from generating under assembly work. High-voltage static electricity discharge destroys the circuit inside the module and it may cause failures.

2-1) HUMIDITY

Maintain a work place in the range of 50 to 70% of relative humidity, to prevent generation and discharge of static electricity.

2-2) GROUNDING

2-2-1) Cover the floor of a work area and a work desk with a conductive mat, and ground them, through resistance with range of 0.5 M to 1M , to prevent discharge all at once.

2-2-2) Workers must wear a grounded wrist band.

2-2-3) Ground all metallic tools, jigs and equipment, such as a soldering iron and a screw driver, jigs, conveyors, or metallic work benches, which are to be used for assembly work.

2-2-4) Do not touch bare metal portions of examination /inspection equipment. It causes to discharge electric charge of an object or a human body.

2-2-5) Do not touch the mounting parts on PCB of LCD module, circuit patterns or connector terminals with worker's hand or conductive tools.

2-3) IONIZER

Using ionizer (an antistatic blower) is recommended at working area in order to reduce electro-static voltage.

3) WORKING AREA

Handle the LCD module in the room without metallic dust. Especially when metallic dust adheres to the LCD module, an internal electric circuit makes short-circuited and it may cause failures.

4) FINGER PRINT

Handle the LCD module fingerstalls or soft and dust-free gloves that do not produce dust when performing incoming inspection of modules or assembling sets. Handling them with bare hand may damage module display quality.

5) REMOVING PROTECTION FILM

The protection film is stuck on an LCD panel before its shipment to prevent dust or scratch on the panel during transportation, assembly work and otherwise. Remove a protection film on an LCD panel near the last process of an assembly to prevent dust and scratch on the panel.

However, remove the film in advance in case of a set attached a module is inserted into high temperature chamber for aging etc. If it is left without removing the film, it may cause irregular polarizer surface.

When removing the protection film, peel off the film from its edge, using round-ended tweezers with Teflon coating or a cellophane tape attached on the edge of the protection film, carefully and slowly, spending more than 3 seconds.

In peeling off the protection film, blow the film using ionizer to eliminate ESD from the film.

Removal which does not comply with the above procedure may generate ESD and damage electric circuit of a LCD module.

*6) WIPING OFF DUST ON THE PANEL

When LCD panel becomes dirty, wipe the panel surface off softly with absorbent cotton or another soft cloth.

If necessary, breathe upon the panel surface and then wipe off immediately and softly again. In case it isn't effective, it is recommended to wipe the panel surface off softly with absorbent cotton or another soft cloth containing a little GALDEN (product name). Then, be careful not to let GALDEN (product name) flow into the inside of LCD module except panel surface.

Be careful not to spill organic solvents into the inside of LCD module. The organic solvents may damage driver IC and PCB area used inside module.

The polarizer laminated to LCD panel and adhesives may be damaged by organic the solvents, so do not use any organic solvents for wiping off LCD panel.

7) PROTECTION AGAINST ADHESION OF ADHESIVE OR GREASE ON A DISPLAY

Be careful not to attach adhesive or grease etc. used for the assembly of a set on a LCD module display. It is difficult to remove them without damaging display quality.

*8) WATER DROP ON A DISPLAY

Do not leave water drop attached on a display. When water drop etc. is attached, wipe it off with absorbent cotton or soft cloth etc. immediately. If it is left without wiped off, a display discolors, or it causes spots. Moreover, moisture's infiltration into the inside causes failures.

*9) HANDLING IN THE CORROSIVE ATMOSPHERE

Do not blow gas or do not use a LCD module beside the normal atmosphere. It may cause failures.

10) INSTALLING LCD MODULE TO THE ENCLOSURE

Do not bend or twist LCD module even momentary when LCD module is installed into an enclosure of the system. Bending or twisting LCD module may cause its damages.

11) FASTENING SCREWS

Fasten equally screws which attach a module in a set,. If not fastened equally, temporarily warping or twisting of the LCD module may cause failures. Then, please manage fastening screws with the prearranged torque or less

12) FOR PREVENTION OF CATCHING CABLES

Be careful not to let cables, etc. for interface caught between a set enclosure and a LCD module while assembling a LCD module in a set.

Assembling with cables caught in may cause bending, twist of a LCD module, or damage and failure of cables.

***13) STRONG MECHANICAL SHOCK**

Avoid strong mechanical shock, such as dropping the LCD from the work bench, or knocking it against a hard object. These may cause the glass panel to crack, or cause other mis-operation.

***14) EXCESSIVE FORCE**

Avoid applying excessive force, like pushing the surface of LCD panel. This may cause scratches or breakage of the panel, or a failure of the module

***15) PREVENTION FOR SCRATCHES ON A DISPLAY**

Be careful not to touch a module display with hard things, such as a tool etc., press a module display with them or rub a module display with them.

Moreover, be careful not to put heavy things, such as a tool etc., or pile up LCD module displays.

As polarizing plates used for a display is easy to be damaged, it may cause scratches, trace, or breakage of the plate.

16) HOW TO INSERT CONNECTOR

Be careful not to apply a strong external force on the connector of a LCD module when inserting or removing cables to connectors of a module. A strong external force may damage internal connections of PCB or TAB driver.

Insert them correctly so that connectors for LCD module input signals and connection connectors of a set are not inserted oblique or half, and be sure to check them.

When inputting signals etc. without inserting them correctly, it may cause failures of circuit parts.

17) HANDLING (FL CABLES AND) FPC

Be careful not to pull FPC or damage FPC or fold FPC. It may break FPC pattern and cause failures.

18) POWER SUPPLY WHILE WORKING/ASSEMBLING

Be sure to turn off the power of a set while working. Pulling out and inserting a LCD module connector with the power of a set turned on may damage a LCD module electric circuit. When turning on the power in a testing process, an inspection process etc., use the power supply and input signals for a drive unit which satisfy the power supply sequence described in this specification.

19) INPUT SIGNAL

The signal should be applied after power supplies are turned on.

The signal should be removed before power supplies are turned off.

The detailed sequence of power supplies and signals are described in this specification.

***20) LCD LONG PERIOD OPERATION**

In case of LCD module long period operation, discoloration of light guide or optical sheet will be happened. As the result, there is a possibility to have out of specification for the optical characteristic.

But this is not irregular phenomena.

For Transportation and Storage**1) STORAGE UNDER HIGH TEMPERATURE AND HIGH HUMIDITY**

Be careful not to store a LCD module for a long time (about one month or more) under the condition of high temperature and high humidity (35 °C or more, 70% or more of relative humidity). This may deteriorate display quality.

When it is necessary to store unavoidably for a long term, in the state of packing by our company (before opening), store it within the range of 0 °C to 35 °C and in the dry place of 70% or less of relative humidity.

2) SOLIDIFICATION ON THE LIQUID CRYSTAL IN CRYOGENIC CONDITION

Since a temperature lower than a rated storage temperature described in this Specification may damage a LCD module liquid-crystal-display panel due to the solidification or contraction etc. on liquid crystal, be careful not to leave it in such a place.

3) BE CAUTIOUS OF STRONG ULTRAVIOLET

Be careful not to expose a LCD module to the sunlight or a fluorescent light directly to protect a LCD module from strong ultraviolet, when storing modules for a long term.

4) CLEANLINESS

Keep the LCD module in clean place, because any dust, hard particle may damage the polarizer, or dust invades the inside of the LCD module.

***5) CONDENSATION OF WATER**

The modules should be stored under a condition which no condensation of water is allowed. It may cause mis-operation or defects. Be especially careful not to make a module work under the condition that condensation of water appears.

6) REPACKAGING

Use the original packing box, material, and method when repacking for transporting and storing it again.

7) NOTES FOR THE ADOPTION OF NEW PACKING MATERIAL

Since some of the cartons for packing or the rubber parts etc. generate corrosive gas, confirm a reliability check in the set assembling state or the packing state before the adoption.