To : Action

This specification is only used for discussing the included items.
You haven't to approve this specification.
When we shall agree the specification, we will issue the formal one.

SPECIFICATION(TENTATIVE)

FOR

Toshiba Matsushita Display Technology A-Grade TFT-LCD MODULE WITHOUT BACKLIGHT

LTH15C503-A

NL-LTH15C503-A-01

DATE OF ISSUE : 2002-07-18

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Revision History

Date	Rev.	Sheet (New)	Item	Old	New	Reason

Caution and Handling Precaution

For your end user's 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.

For Safety

⚠ Warning

(1) Toshiba Matsushita Display Technology's Standard LCD modules without backlights have not been customized for operation in extreme environments or for use in applications where performance failures could be life-threatening or otherwise catastrophic.
Since they must never be installed in aircraft navigation control systems (such as, but not limited to Traffic Collision System and Air traffic Indicator), in military defense or weapons systems, in critical industrial process-control systems (e.g., those involved in the production of nuclear energy), or in critical medical device or patient life-support systems.

(2) DISCONNECT POWER SUPPLY before handling LCD module without backlight.
DO NOT TOUCH the circuit of module without backlight under operation, because high voltage is impressed partially such as the coil etc. on PCB.

⚠ Caution

(1) DO NOT DISASSEMBLE OR MODIFY the module.
Sensitive parts inside LCD module without backlight may be damaged, and dusts or scratches may mar the displays.
Toshiba Matsushita Display Technology Co., Ltd. does not warrant the modules without backlights, if customer disassembled or modified them.

□(2) DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT PERMIT this material to contact the skin, if LCD panel is broken and liquid crystal material spills out.
In the event of inadvertent contact, immediately rinse the mouth or eyes with adequate water. If this material should inadvertently contact the skin or clothing, wash immediately with alcohol and then rinse thoroughly with water.

□(3) BE CAREFUL WITH CHIPS OF GLASS that may cause injuring fingers or skin, when the glass is broken.
This module without backlight should be careful enough at the glass edge not to cut hand etc. for bare glass.

(4) DO NOT EXCEED the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts' constants, ambient temperature, etc., otherwise LCD module without backlight may be damaged.

(5) Suitable protection circuit should be applied for each system design.
DO NOT MODIFY the fuse used in the module. It may cause overheat and/or burning if dusts or metal particles are on the PCBs in the LCD module without backlight.

(6) Be sure that power supply output from the system should be limited to smaller values than listed shown below. (For example Quick Arcing Fuse with listed ratings can be used.)
It is because this LCD module without backlight explained in this specification has a current limiter, with such function at power input line(s). But it may be some possibility of overheat and/or burning of LCD module without backlight and its peripheral devices before current limiter of the module without backlight when open-short test of the module without backlight is performed by using power supply higher than following recommended value.

Power supply	Recommended maximum output current of power supply	Recommended Fuse Rating (in case of using fuse for current limiter)	Built-in Fuse Rating (for reference)
V_{DD}	4.0 A	1.25 A	1.25 A

(7) Always comply with all applicable environmental regulations, when disposing of LCD.

For Designing the System

(1) When assembling the glass portion into the backlight unit, determine a positioning part and fix the circumference of glass on a double-sided tape etc. Mechanical parts should be designed so that stress may not be applied to inlet of the glass downside. When assembling the PCB portion into the set, fix PCB in places other than part mounting domain.

(2) Power supply lines should be designed as follows.
Power supplies should always be turned on before the input signals are supplied to LCD module without backlight, and the input signals should be disconnected before power supplies are turned off.
If the sequence does not satisfy specified conditions, it may cause miss-operation of the panel.
Refer to "2.4.2 Sequence of Power Supplies and Signals" for the detailed specification.

(3) The set case should be designed so that stress such as twist and bend may not be applied to module when assembling the glass portion into the backlight unit and using the set.
The set case should be designed so that stress such as twist, bend and stretching may not be applied to the connection of TAB when bending TAB at the process of assembly.

(4) This LCD is designed for note PC and assumes about 2000 cd/m^2 as luminance of the backlight used.
When the backlight of the luminance beyond 2000 cd/m^2 is used, luminance should be set up after evaluating enough the product characteristics, such as module display operation, grace and reliability and checking that it is satisfactory.

(5) Please adjust inverter circuit parameters, such as capacitor, resistor, to assure the display quality is maintained.
There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency).

(6) In case of severe environmental condition like outdoor usage, a proper transparent protective cover(lens) over LCD module without backlight is recommended to apply in order to prevent scratches, and invasion of dust, water, etc., from the system's window onto LCD module without backlight.
Ultra-violet ray cut filter is recommended to apply onto LCD module without backlight for outdoor operation. Strong ultra-violet ray may cause damage the panel.

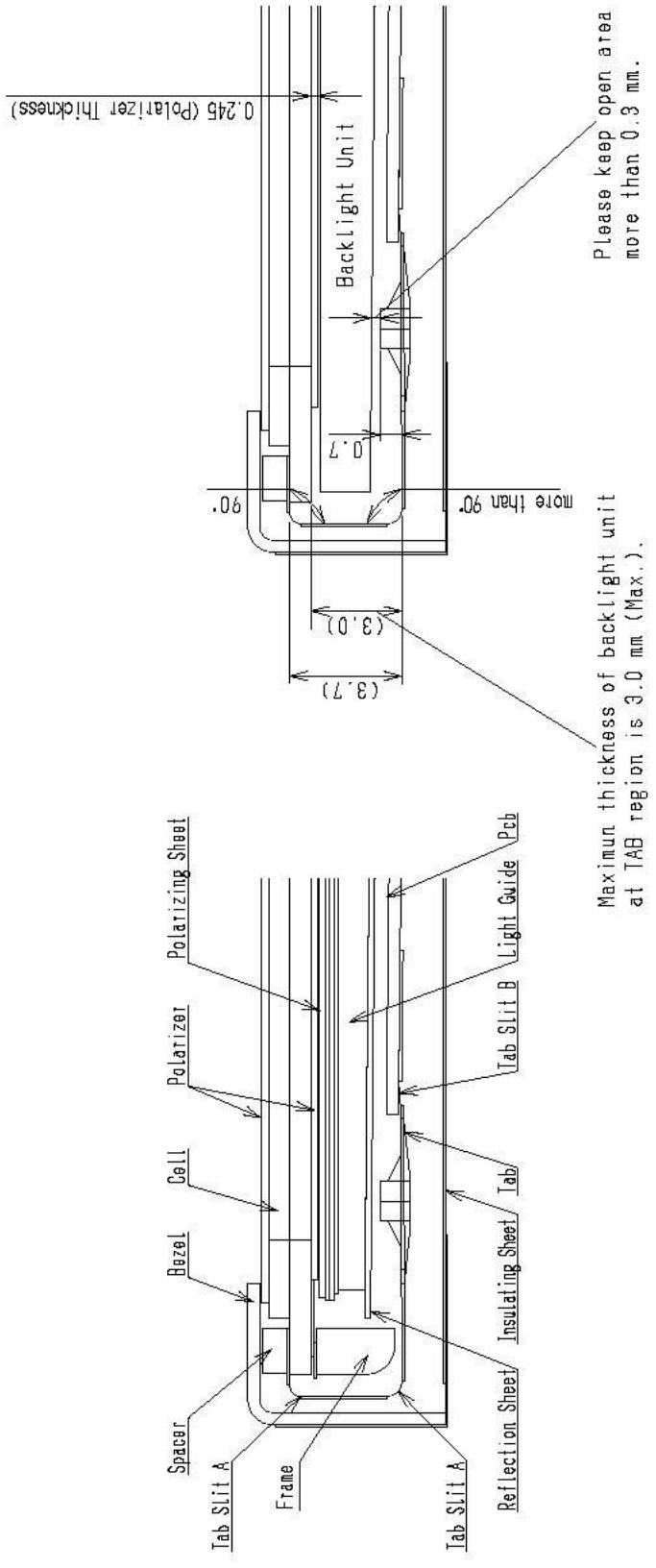
(7) Design the system not to display same pattern for a long time in order to prevent image sticking on the panel. Note that incorrect sequence of power supplies and input signals may cause the sticking on the panel, too.

(8) Application Notes

This is the longitudinal section of LTM15C503-A module which is comprized with LTH15C503-A module without backlight. Please refer to this data for your backlight design.

Regarding to TAB bending position, please don't bend TAB in the position of slit B, only use slit A position for bending.

Unit : mm



For Installation in Assembly

(1) The C-MOS LSIs used in LCD module without backlight are very sensitive to ESD (Electro-static Discharge).
Ambient humidity of working area is recommended to be higher than 50%(RH).
Person handling LCD module without backlights should be grounded with wrist band. Tools like soldering iron and screw driver, and working benches should be grounded.
The grounding should be done through a resistor of 0.5-1M? in order to prevent spark of ESD.

(2) When remove protection film from LCD panel, peel off the film slowly (more than three seconds) from the edge of the panel, using a soft-pointed tweezers covered by teflon or adherent tape.

(3) Reduce dust level in working area. Especially the level of metal particle should be decreased.
Use finger stalls or soft and dust-free gloves in order to keep clean appearance of LCD module when handled for incoming inspection and assembly.

(4) When LCD panel becomes dirty, wipe off the panel surface softly with absorbent cotton or another soft cloth.
If necessary, breathe upon the panel surface and then wipe off immediately and softly again.
If the dirt can not be wiped off, absorbent cotton wetted a little with normal-hexane or petroleum benzine can be used for wiping the panel.
Be careful not to spill this solvent into the inside of LCD module. Driver ICs and PCB area used inside LCD module may be damaged by the solvent.

(5) AVOID THE CONDENSATION OF WATER
Wipe off a spot or spots of water of mist and chemicals of mist on LCD panel softly with absorbent cotton or another cloth as soon as possible if happened, otherwise discoloration or stain may be caused. If water invade into LCD module, it may cause LCD module damages.

(6) Do not expose LCD module to the gas (which is not normally contained in the atmosphere), it may cause mis-operation or defects.

(7) DO NOT APPLY MECHANICAL FORCES.
Do not bend or twist LCD module without backlight even momentary when LCD module without backlight is installed an enclosure of the system. Bending or twisting LCD module without backlight may cause its damages.
Make sure to design the enclosure that bending/twisting forces are not applied to LCD module without backlight when it is installed in the system.
Refrain from strong mechanical shock like dropping from the working bench or knocking against hard object.
These may cause glass of the panel crack, damage of FL or other mis-operation.

(8) Refrain from excessive force like pushing the surface of LCD panel. This may cause damage of the panel or electrical parts on PCB.

(9) Do not put heavy object such as tools, books, etc., and do not pile up LCD modules.
Be careful not to touch surface of the polarizer laminated to the panel with any hard and sharp object. The polarizer is so soft that it can easily scratched, even the protect film covers it.

(10) When inserting or disconnecting the connectors to LCD module, be sure not to apply force against PCB, nor connecting cables, otherwise internal connection of PCB and TAB drivers may be damaged.
Do not fasten screws while putting cables like those for interface or FL between LCD module without backlight and the enclosure.

(11) Be careful not to pull or not to hurt the FPC (Flexible Printed Circuit) cables.

(12) Power supplies should always be turned off in assembling process.
Do not connect or disconnect the power cables and connectors with power applied to LCD module without backlight. This may cause damage of module circuit.
The signal should be applied after power are turned on. And the signal should be removed before power supplies are turned off. (Refer to "For Designing The System"(2).)

(13) When module without backlight is carried by hand, please hold the glass edge with both hands.
If PCB and TAB are held, it will become the cause of failure and It may be some possibility of overheat and/or burning of module without backlight
If the surface and the back of glass are held directly, it will become the cause of poor display such as scratch and stain.
In addition, when module without backlight is carried by hand, wear finger sack or soft glove out of which dust dose not come, and be careful not to cut a hand with edge of glass etc.

For Installation in Backlight Unit

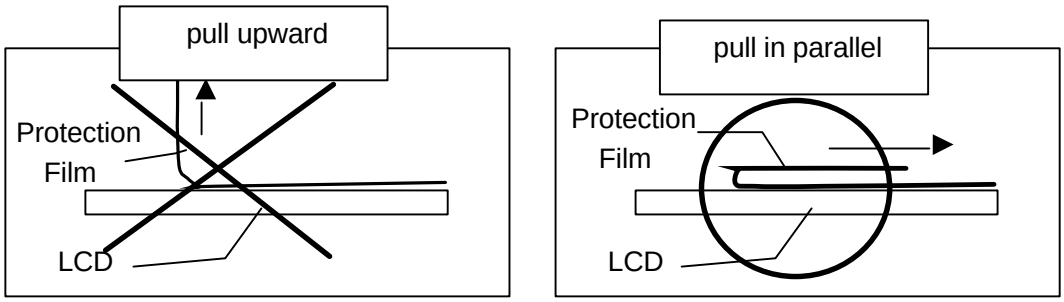
When assembling this module without backlight into the backlight unit and mechanical component, introduce electro static destruction countermeasure as follows into the process of assembly, and be careful not to destroy module without backlight with static electricity.

(1) Clothes
Please wear electric conduction shoes.
Please use list strap with cable.

(2) Environment of process
Please use floor as electric conduction floor.
The work stand surface on which module without backlight is put should use conductive rubber mat.
Please ground conductive rubber mat.
Module without backlight should prevent from touching direct matal.
Module without backlight should remove static electricity by ionizer.
Please determine the distance from ionizer to module without backlight after checking the effect which removes static electricity.
Please turn the blow direction of ionizer to the place which static electricity generates.
The amount of electrifications at the time of non-working at the process should be controlled less than 300V.

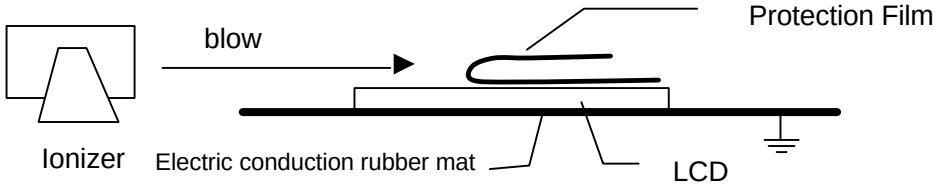
(3) Notes at the time of protection film exfoliation

Please pull the protection film in parallel to glass surface and exfoliate protection film slowly (more than three seconds).



Please blow the portion which exfoliates the protection film by ionixer.

LCD should be placed on the grounded electric conduction rubber mat.



When sticking the exfoliative protection film on LCD again, please stick it after removing static electricity.

It is the same when sticking a new protection film.

Please remove product label on the protection film after removing the protection film in order to prevent damage to cell.

(4) Check item

The ion balance of ionizer should be measured periodically and should be adjusted.

Ionizer should be cleaned once per week.

Please check list strap by the list strap checker whenever starting work.

Please check the conductive check of electric conduction shoes whenever starting work.

(5) Air conditioning

Humidity should be controlled at 50?20 (%(RH)).

Temperature should be controlled at 20?5 (?C)

Wind direction and wind power of air-conditioner should be adjusted so that wind of air-conditioner may not hit a LCD directly.

(6) Takeout of module without backlight from packing tray

When taking module without backlight from packing tray and putting it on worktable, please put it on worktable after removing static electricity by ionizer.

When taking module without backlight from packing tray, be careful to catch neither PCB nor TAB in packing carton and tray.

(7) Transportation at line

When transporting module without backlight with a cart etc., the cart should be grounded by chain etc.

(8) Implement

When using a metal implement, please use it after making it discharge once.

When testing LCD and processing LCD, please ground the portion in contact with LCD of implement.

When connecting a signal cable to module without backlight for check of operation etc., please connect a cable to module without backlight after fully removing the static electricity of LCD.

For Transportation and Storage

(1) Do not store LCD module without backlight in high temperature, especially in high humidity for a long time (approximately more than one month).

It is recommended to store LCD module without backlight where the temperature is in the range of 0 to 35 ?C and the relative humidity is lower than 70%.

(2) Store LCD module without backlight without exposure to direct sunlight or fluorescent lamps in order to prevent the module from strong ultra violet ray.

(3) Avoid condensation of water on LCD module without backlight, otherwise it may cause mis-operation or defects. Keep away LCD module without backlight from such ambient.

(4) In case of transportation of storage after opening the original packing. LCD module without backlight are recommended to be repacked into the original packaging with the same method, especially with same kind of desiccant.

Handling Notice

(1) How to pull out from carton

OK Pull up at both side of outer sack.

Notice: Do not tilt bag.

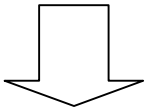
NG Do not pull up by only one hand.

(2) How to pull out from tray

OK Insert fingers between tray and panel.

NG Do not handle by only one hand.

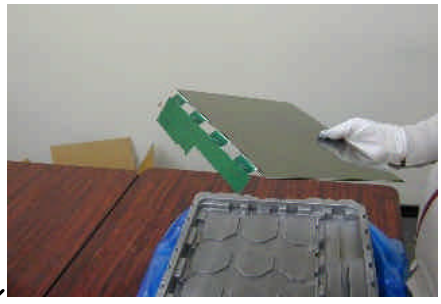
It's due to disconnection between panel and TAB-ICs.



OK Bring up slowly.

NG Do not handle at PCB.

It's due to disconnection between panel and TAB-ICs.



NG Do not turn over.

It's due to disconnection between panel and TAB-ICs.

(3) How to return the module without backlight to the tray

Keep straightly panel and PCB.

OK

Put on slowly.

OK

Notice: Do not put TAB-ICs on projections.

- CONTENTS -

1. Scope

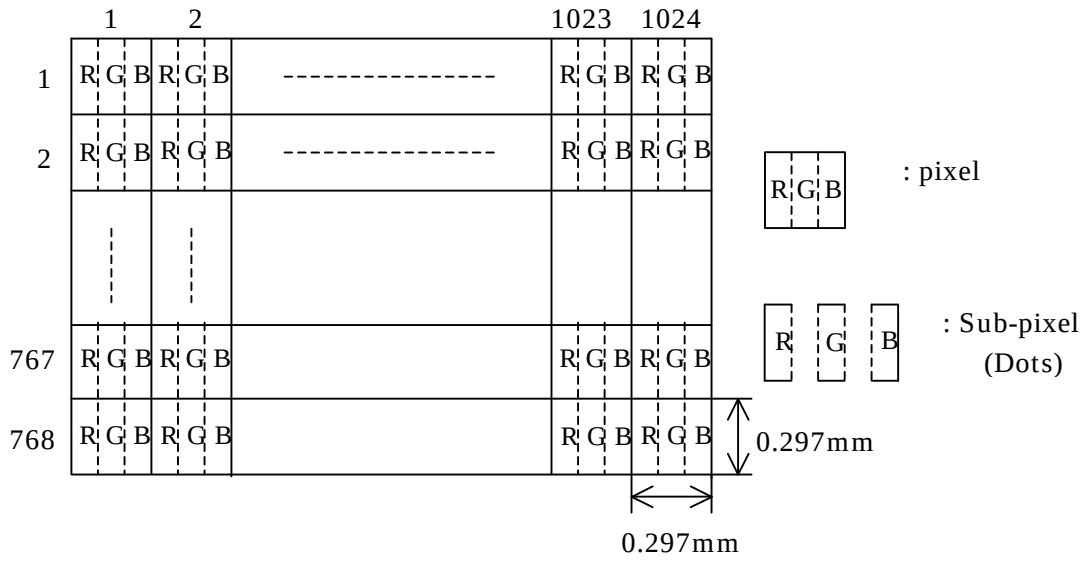
This specification is applicable to Toshiba Matsushita Display Technology's 38cm diagonal size A-Grade TFT-LCD module without backlight "LTH15C503-A" designed for Note PC.

2. Product Specifications

2.1 General Specifications

Item	Specifications
Display Mode	TN color(64 gray scales, 262,144 colors) Transmissive type, Normally white
Viewing Direction	6 o'clock (in direction of maximum contrast)
Driving Method	TFT active matrix
Input Signals	LVDS interface CLK+, CLK-, RxIN0+, RxIN0-, RxIN1+, RxIN1-, RxIN2+, RxIN2-
Active Area	304.128 (*W*) ? 228.096 (*H*) (mm)
Number of Pixels	1024 (*W*) ? 768 (*H*) [1)]
Pixel Pitch	0.297 (*W*) ? 0.297 (*H*) (mm) [1)]
Pixel Arrangement	RGB vertical stripes [1)]
Surface Treatment	Anti-glare and hard coat 2H on LCD surface
Dimensional Outline of Glass	310.9 (*W*) ? 235.7 (*H*) ? 1.89 (*D*) (mm)
Transmission axis direction of polarizer (at the time of looking from front)	45 degree (inclination with X-axis) (refer to 2.3.2 Dimensional Outline)

Note 1)



2.2 Absolute Maximum Ratings [1)]

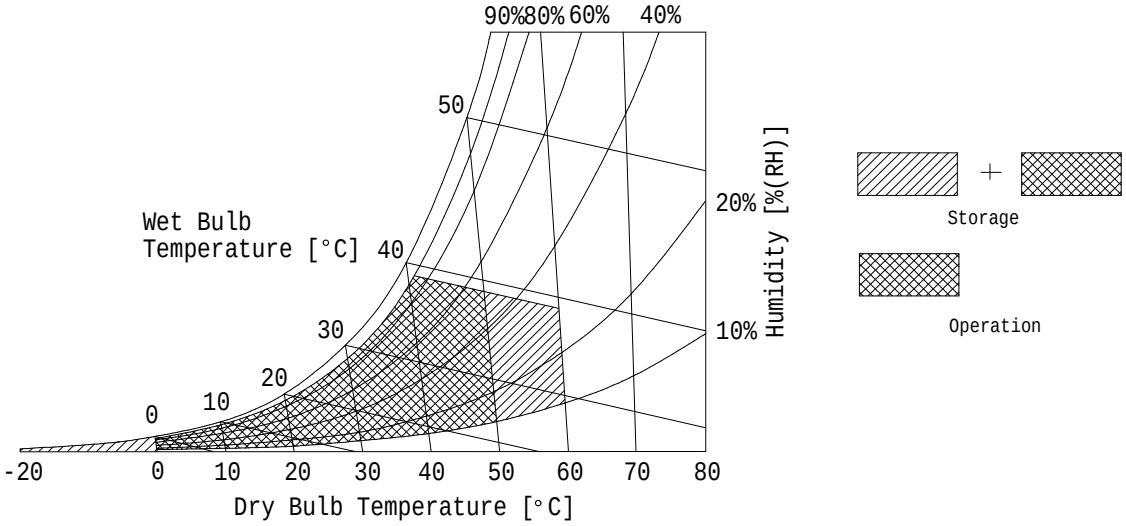
Item	Symbol	Min.	Max.	Unit	Checked Terminal [4)]
Supply Voltage	V_{DD}	-0.3	+4.0	V	V_{DD} - GND
Input Voltage of Signals	V_{IN}	-0.3	V_{DD}+0.3	V	LVDS interface
Operating Ambient Temperature [2)]	T_{OP}	0	50	?C	
Operating Ambient Humidity [2)]	H_{OP}	10	90	%(RH)	
Storage Temperature [2)]	T_{STG}	-20	+60	?C	
Storage Humidity [2)]	H_{STG}	10	90	%(RH)	
Operating Temperature for Panel [3)]	-	0	+60	?C	

Note 1) Do not exceed the maximum rating values under the worst probable conditions taking into account the supply voltage variation, input voltage variation, variation in part constants, and ambient temperature and so on. Otherwise the module may be damaged.

2) Wet bulb temperature should be 39?C Max, and no condensation of water. See figure below.

3) The surface temperature caused by self heat radiation of cell itself is specified on this item.

4) Refer to 2.4.5



2.3 Mechanical Specifications

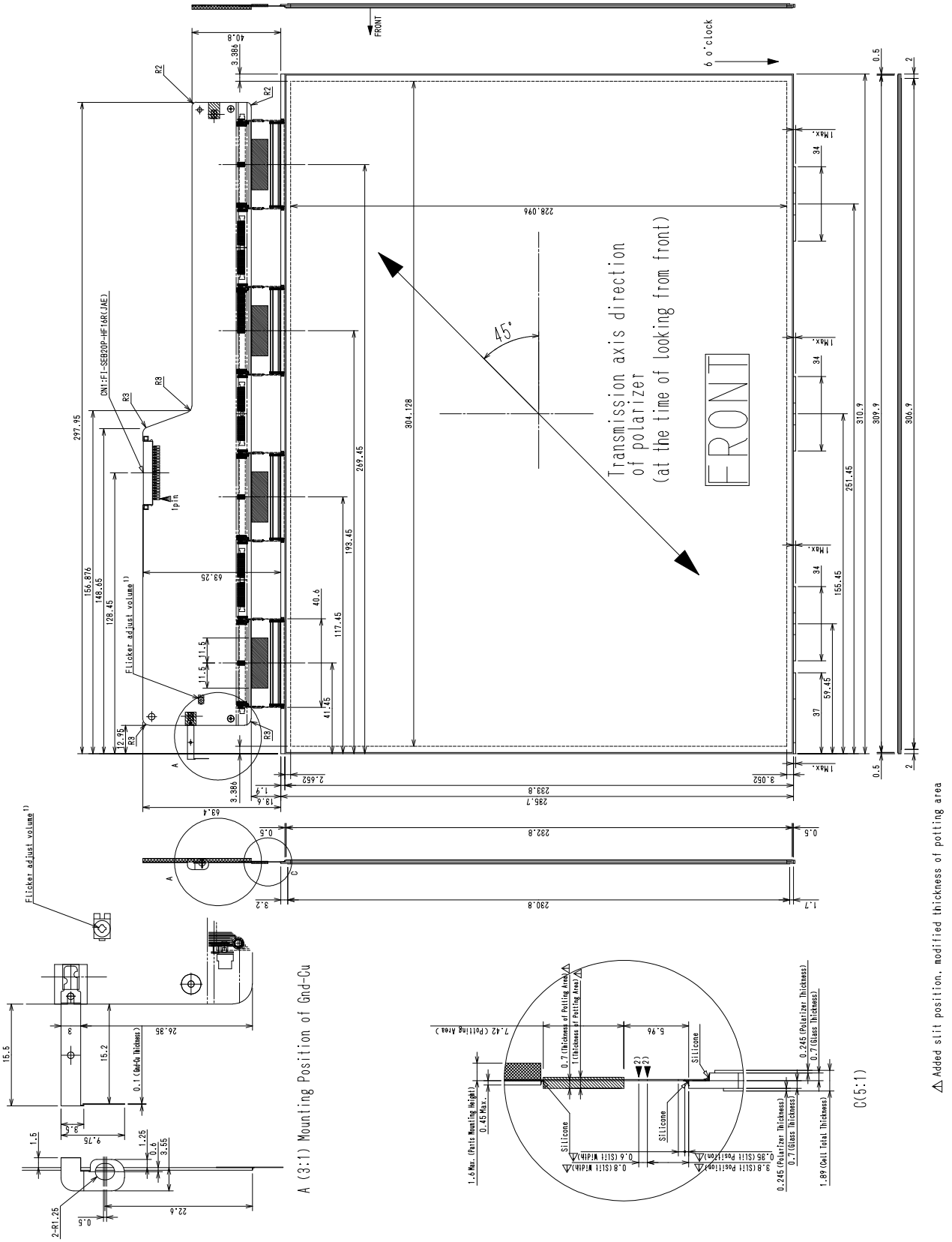
2.3.1 Weight

319g ? 20 g

2.3.2 Dimensional Outline

Unit : mm

Standard Tolerance : ? 0.5

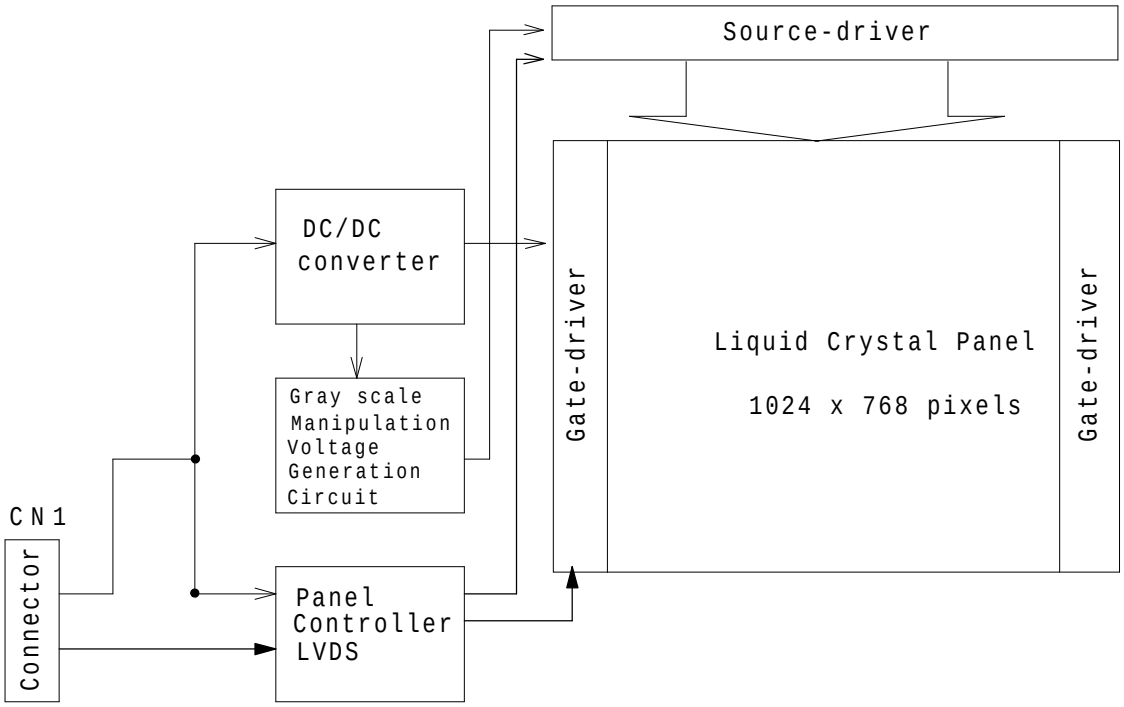


Note 1) Please don't touch and don't turn the flicker volume on PCB. If the flicker volume is touched and turned, it becomes the cause of flicker or image sticking.

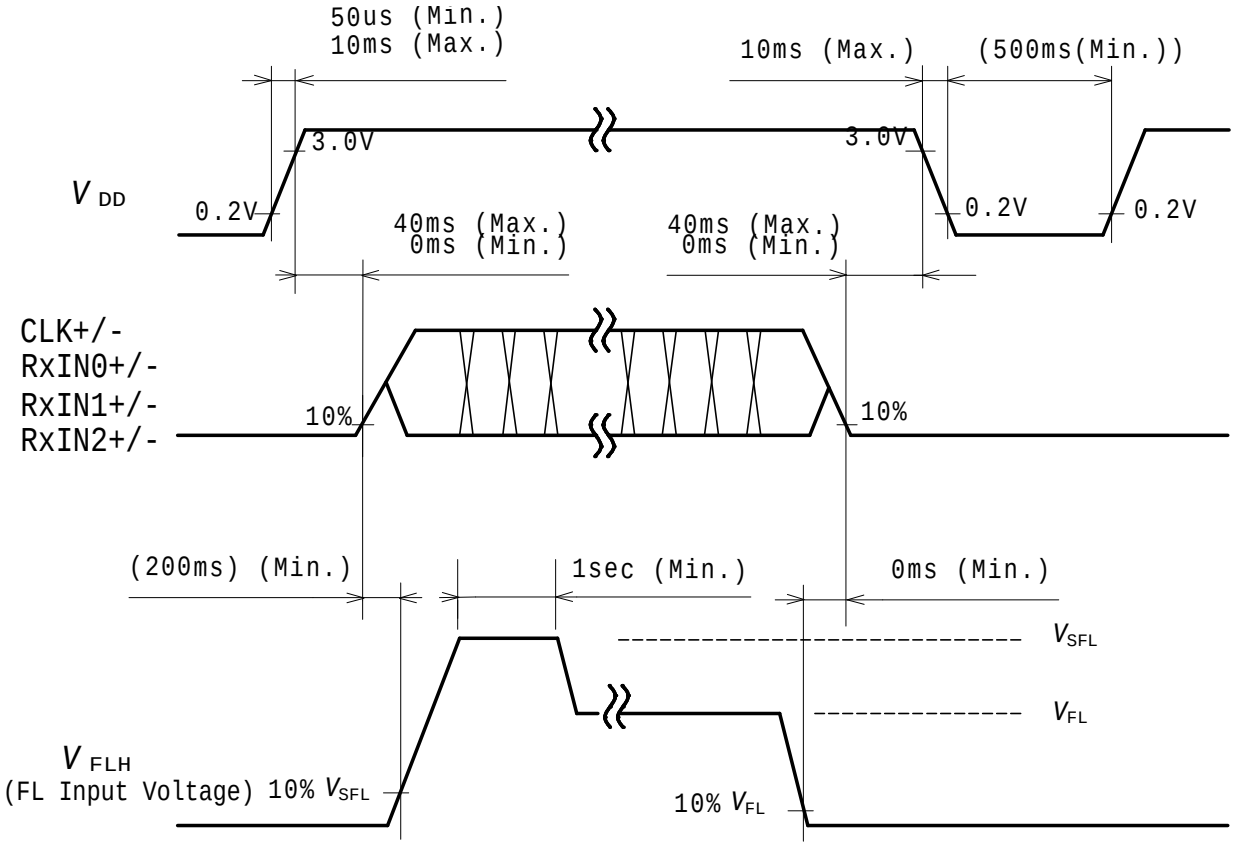
Note 2) TAB bending position (Please don't bend in any position other than this position. Refer to "For Designing the System"(8).)

2.4 Electrical Specifications

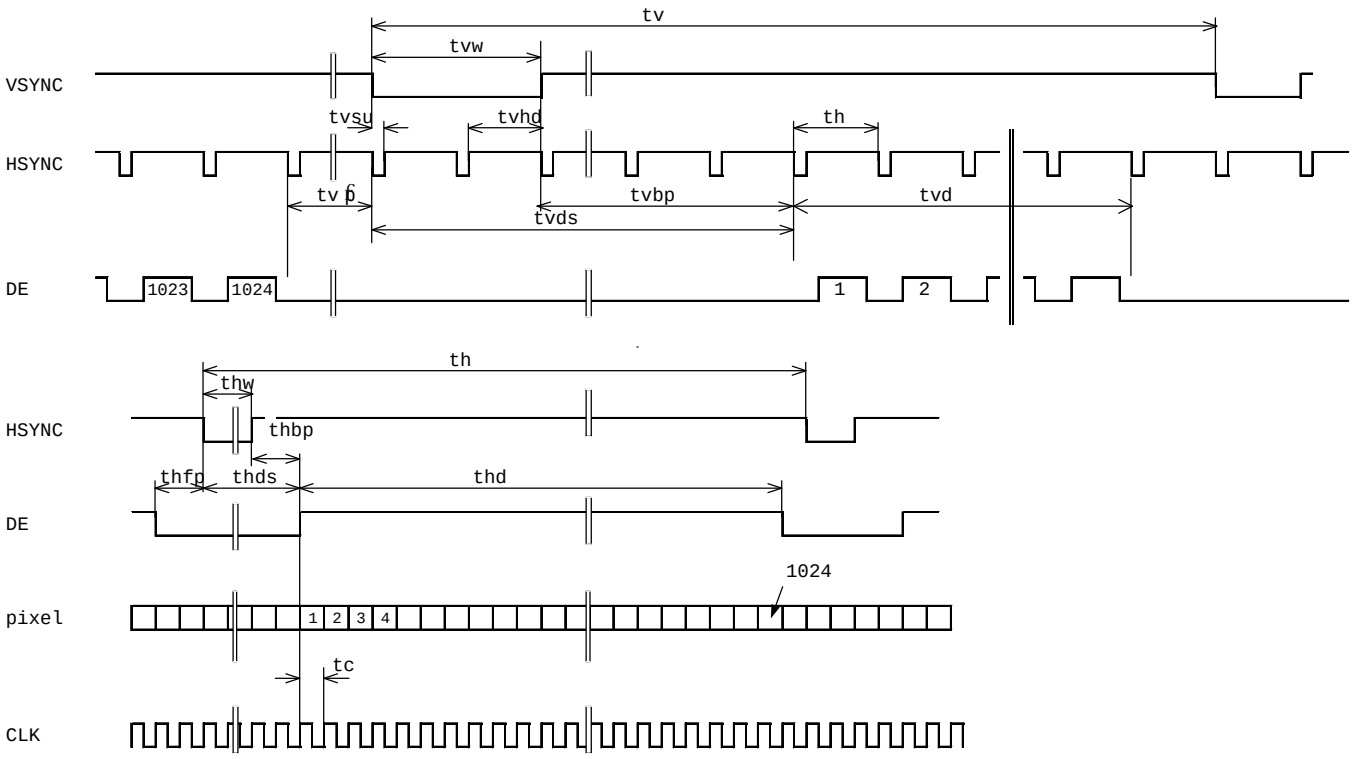
2.4.1 Circuit Diagram



2.4.2 Sequence of Power Supplies and Signals



2.4.3 Timing Chart



2.4.4 Timing Specifications [1) 2) 3) 4) 5) 6)]

Item	Symbol	min.	typ.	max.	unit
Horizontal Scanning Term	*t*h	1334 x *t*c	1344 x *t*c	-	clock
H-sync Pulse Width	*t*hw	4 x *t*c	136 x *t*c	-	clock
Horizontal Front Porch	*t*hfp	4 x *t*c	24 x *t*c	-	clock
Horizontal Back Porch	*t*hbp	24 x *t*c	160 x *t*c	-	clock
Horizontal Data Sync Period	*t*hds	32 x *t*c	296 x *t*c	-	clock
Horizontal Display Term	*t*hd	1024 x *t*c	1024 x *t*c	1024 x *t*c	clock
Frame Period	*t*v	-	806 x *t*h	-	line
Frame Frequency	1/ *t*v	60	60	60	Hz
V-sync Pulse Width	*t*vw	2 x *t*h	6 x *t*h	-	line
V-sync Set Up Time (to H-sync)	*t*vsu	8 x *t*c	-	-	clock
V-sync Hold Time	*t*vhd	(thbp+16) x *t*c	-	-	clock
Vertical Front Porch	*t*vfp	1 x *t*h	3 x *t*h	-	line
Vertical Back Porch	*t*vbp	2 x *t*h	29 x *t*h	-	line
Vertical Data Sync Period	*t*vds	8 x *t*h	35 x *t*h	-	line
Vertical Display Term	*t*vd	768 x *t*h	768 x *t*h	768 x *t*h	line
Clock Period	*t*c	15.0	15.38	-	ns

Note 1) Refer to “Timing Chart” and LVDS (THC63LVDF84A-85) specifications by THine Electronics,Inc.

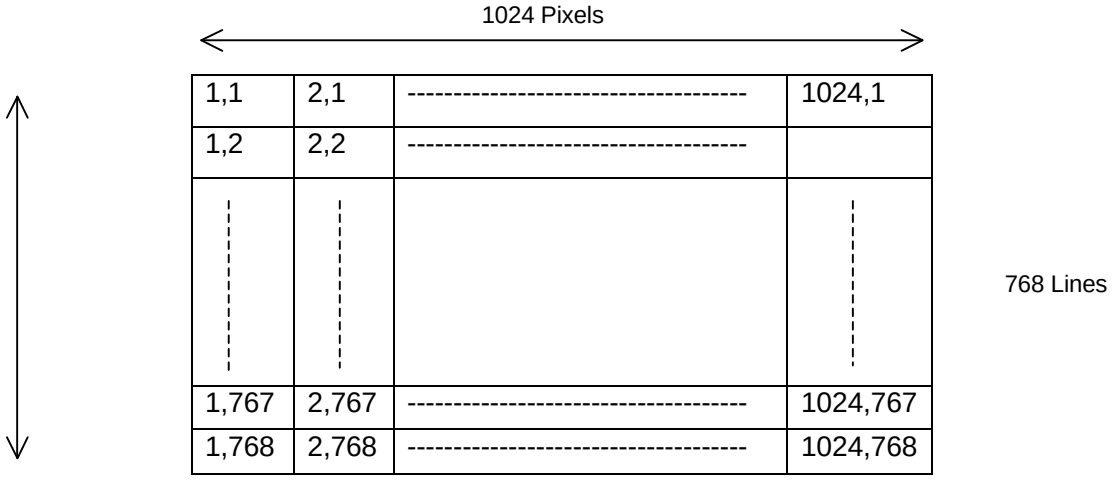
Note 2) If NCLK is fixed to "H" or "L" level for certain period while V_{DD} is supplied, the panel may be damaged.

Note 3) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality.
There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency), even if the condition satisfies above timing specifications.

Note 4) Do not make *t*v, *t*vhd and tvds fluctuate.
If *t*v, *t*vhd, and *t*vds are fluctuate, the panel displays black.

Note 5) In case of using the long frame period, the deterioration of display quality, noise etc. may be occurred.

Note 6) NCLK count of each Horizontal Scanning Time should be always the same.
V-Blanking period should be “*n*” X “Horizontal Scanning Time”. (*n*: integer)
Frame period should be always the same.



2.4.5 Interface Connector

CN1 INPUT SIGNAL

Connector : FI-SEB20P-HF16R / Japan Aviation Electronics Ind,Ltd.

Mating Connector : FI-S20S(Housing), FI-C3-A1-15000(Contact) or FI-SE20M(FRC Type) / JAE

Terminal No.	Symbol	Function
1	V_{DD}	Power Supply : +3.3V
2	V_{DD}	Power Supply : +3.3V
3	GND	GND
4	GND	GND
5	RxIN0-	Negative LVDS differential data input (R0-R5,G0)
6	RxIN0+	Positive LVDS differential data input (R0-R5,G0)
7	GND	GND
8	RxIN1-	Negative LVDS differential data input (G1-G5, B0-B1)
9	RxIN1+	Positive LVDS differential data input (G1-G5, B0-B1)
10	GND	GND
11	RxIN2-	Negative LVDS differential data input (B2-B5, HS, VS, DE)
12	RxIN2+	Positive LVDS differential data input (B2-B5, HS, VS, DE)
13	GND	GND
14	CLK-	Clock Signal(-)
15	CLK+	Clock Signal(+)
16	GND	GND
17	NC	
18	NC	
19	GND	GND
20	GND	GND

Note 1) Please connect GND pin to ground. Don't use it as no-connect nor connection with high impedance.

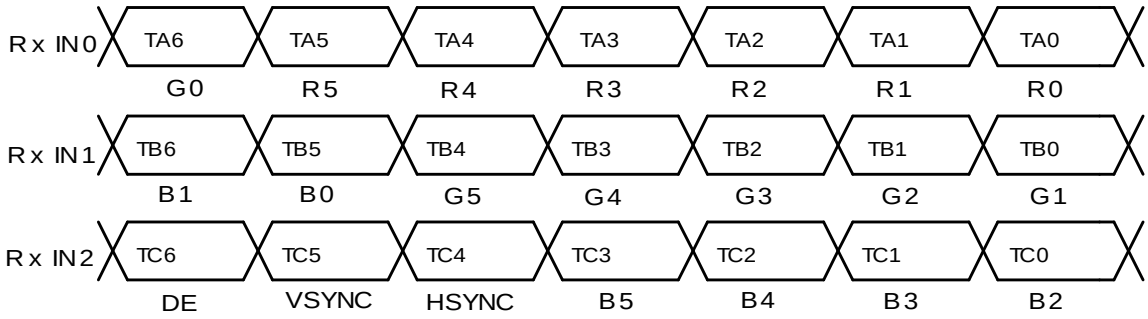
Note 2) Please connect NC pin to nothing. Don't connect it to ground nor to other signal input.

2.4.6 Recommended Transmitter Interface Assignment

Case1: 6bit Transmitter

THC63LVDF63A, THC63LVDM63A, THC63LVDM63A-85					**Module without backlight LTH15C503-A Interface** (CN1)	
Input Terminal No.		Input Signal (Graphics controller output signal)		Output Signal Symbol		
Symbol	Terminal	Symbol	Function		Terminal	Symbol
TA0	44	R0	Red Pixels Display Data (LSB)	TA- TA+	No.5 No.6	RxIN0- RxIN0+
TA1	45	R1	Red Pixels Display Data			
TA2	47	R2	Red Pixels Display Data			
TA3	48	R3	Red Pixels Display Data			
TA4	1	R4	Red Pixels Display Data			
TA5	3	R5	Red Pixels Display Data (MSB)			
TA6	4	G0	Green Pixels Display Data (LSB)			
TB0	6	G1	Green Pixels Display Data	TB- TB+	No.8 No.9	RxIN1- RxIN1+
TB1	7	G2	Green Pixels Display Data			
TB2	9	G3	Green Pixels Display Data			
TB3	10	G4	Green Pixels Display Data			
TB4	12	G5	Green Pixels Display Data (MSB)			
TB5	13	B0	Blue Pixels Display Data (LSB)			
TB6	15	B1	Blue Pixels Display Data			
TC0	16	B2	Blue Pixels Display Data	TC- TC+	No.11 No.12	RxIN2- RxIN2+
TC1	18	B3	Blue Pixels Display Data			
TC2	19	B4	Blue Pixels Display Data			
TC3	20	B5	Blue Pixels Display Data (MSB)			
TC4	22	HSYNC	Horizontal Synchronization Signal			
TC5	23	VSYNC	Vertical Synchronization Signal			
TC6	25	DE	Compound Synchronization Signal			
CLK IN	26	CLK	Data Sampling Clock	TCLK- TCLK+	No.14 No.15	CLK- CLK+

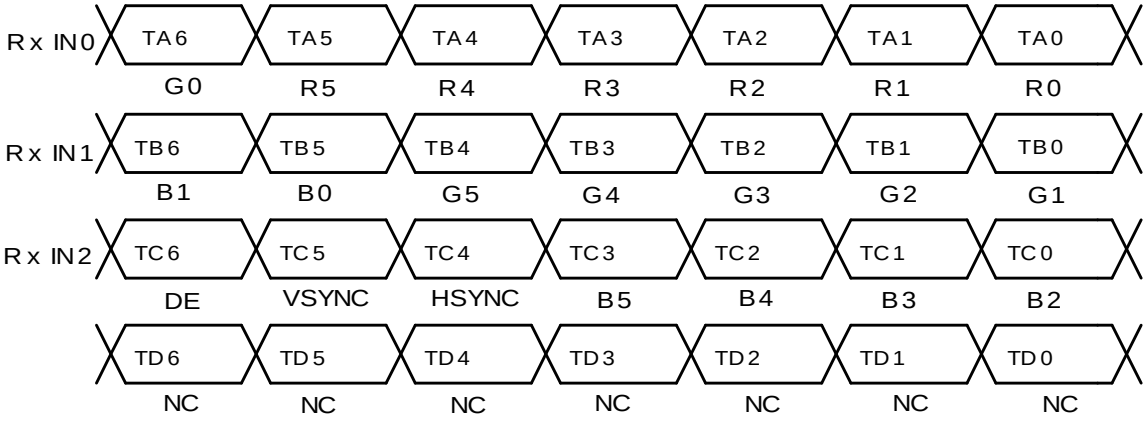
Note 1) Please refer to LVDS transmitter (THC63LVDF63A, THC63LVDM63A, THC63LVDM63A-85) specifications by THine Electronics, Inc.



Case2: 8bit Transmitter

THC63LVDF83A, THC63LVDM83A, THC63LVDM83A-85					**Module without backlight LTH15C503-A Interface** (CN1)	
Input Terminal No.		Input Signal (Graphics controller output signal)		Output Signal Symbol		
Symbol	Terminal	Symbol	Function		Terminal	Symbol
TA0	51	R0	Red Pixels Display Data (LSB)	TA- TA+	No.5 No.6	RxIN0- RxIN0+
TA1	52	R1	Red Pixels Display Data			
TA2	54	R2	Red Pixels Display Data			
TA3	55	R3	Red Pixels Display Data			
TA4	56	R4	Red Pixels Display Data			
TA5	3	R5	Red Pixels Display Data (MSB)			
TA6	4	G0	Green Pixels Display Data (LSB)			
TB0	6	G1	Green Pixels Display Data	TB- TB+	No.8 No.9	RIxN1- RxIN1+
TB1	7	G2	Green Pixels Display Data			
TB2	11	G3	Green Pixels Display Data			
TB3	12	G4	Green Pixels Display Data			
TB4	14	G5	Green Pixels Display Data (MSB)			
TB5	15	B0	Blue Pixels Display Data (LSB)			
TB6	19	B1	Blue Pixels Display Data			
TC0	20	B2	Blue Pixels Display Data	TC- TC+	No.11 No.12	RxIN2- RxIN2+
TC1	22	B3	Blue Pixels Display Data			
TC2	23	B4	Blue Pixels Display Data			
TC3	24	B5	Blue Pixels Display Data (MSB)			
TC4	27	HSYNC	Horizontal Synchronization Signal			
TC5	28	VSYNC	Vertical Synchronization Signal			
TC6	30	DE	Compound Synchronization Signal			
TD0	50	NC	Non Connection (open)	TD- TD+	———	———
TD1	2	NC	Non Connection (open)			
TD2	8	NC	Non Connection (open)			
TD3	10	NC	Non Connection (open)			
TD4	16	NC	Non Connection (open)			
TD5	18	NC	Non Connection (open)			
TD6	25	NC	Non Connection (open)			
CLK IN	31	CLK	Data Sampling Clock	TCLK- TCLK+	No.14 No.15	CLK- CLK+

Note 1) Please connect NC pin to nothing. Don't connect it to ground nor to other signal input.
Note 2) Please refer to LVDS transmitter (THC63LVDF83A, THC63LVDM83A, THC63LVDM83A-85) specifications by THine Electronics, Inc.



2.4.7 Colors Combination Table

	Display	MSB R5	R4	R3	R2	R1	LSB R0	MSB G5	G4	G3	G2	G1	LSB G0	MSB B5	B4	B3	B2	B1	LSB B0	Gray Scale Level
Basic Color	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	-
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	-
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	-
	Light Blue	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	-
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	-
	Purple	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H	-
	Yellow	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L	-
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
Gray Scale of Red	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	Dark ? ? Light	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L 1
		L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L 2
		:						:						:						L3?
		:						:						:						L60
		H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L61
		H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L62
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	Red L63
Gray Scale of Green	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	Dark ? ? Light	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L 1
		L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L 2
		:						:						:						L3?
		:						:						:						L60
		L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L	L61
		L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L62
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	Green L63
Gray Scale of Blue	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	Dark ? ? Light	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L 1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L 2
		:						:						:						L3?
		:						:						:						L60
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	L61
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L62
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	Blue L63
Gray Scale of White & Black	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	Dark ? ? Light	L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L 1
		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L	L 2
		:						:						:						L3?
		:						:						:						L60
		H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L61
		H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L62
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	White L63

3. Recommended Operating Conditions [1) 6)]

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	3.0	3.3	3.6	V	[3)]
Differential Input Voltage	V_{ID}	100	---	600	mV	[4)]
Comon Mode Input Voltage	V_{CM}	1.0	---	2.4-V_{ID} /2	V	[5)]

Note 1) The module should be always operated within these ranges. The "Typ." shows the recommendable value.

Note 2) Recommended LVDS transmitter: THC63LVDF63A, THC63LVDM63A, THC63LVDM63A-85, THC63LVDF83A, THC63LVDM83A, THC63LVDM83A-85 (made by THine Electronics,Inc.)

Panel Controller contains LVDS, which is based on THC63LVDF84A-85 (made by THine Electronics,Inc.) specification.

Note 3) Checked Pin Terminal : V_{DD} , GND (GND : Vss = 0V)

Note 4) Checked Pin Terminal: IN0-～CLK+, GND (0V)

Measure:|V_{IN0+} - V_{IN0-}|, |V_{IN1+} - V_{IN1-}|, |V_{IN2+} - V_{IN2-}|, |V_{CLK+} - V_{CLK-}|

Note 5) Checked Pin Terminal: IN0-～CLK+, GND (0V)

Measure:1/2 x (V_{IN0+} + V_{IN0-}), 1/2 x (V_{IN1+} + V_{IN1-}), 1/2 x (V_{IN2+} + V_{IN2-}), 1/2 x (V_{CLK+} + V_{CLK-})

Note 6) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality.

There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency), even if the condition satisfies above recommended operating conditions and timing specifications shown in 2.4.4.

4. Electrical Characteristics

4.1 Test Conditions

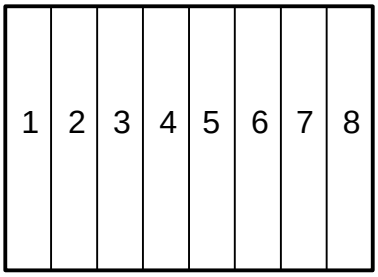
Ambient Temperature : T_a 25?5?C
Ambient Humidity : H_a 65?20%(RH)
Supply Voltage : V_{DD} 3.3V
Input Signal : Refer typical value in "2.4.4 Timing Specifications".

4.2 Specifications

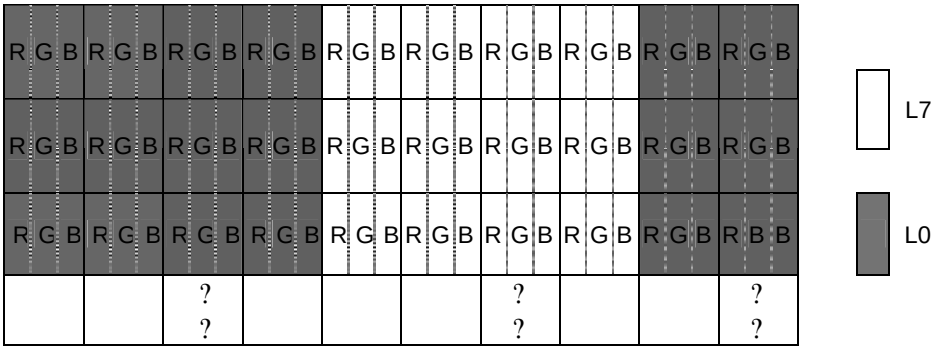
Item	Symbol	Min.	Typ.[1)]	Max.[2)]	Unit	Remark
Current Consumption	I_{DD}	-	240	400	mA	V_{DD} Terminal Current

Note 1) The Typical value of I_{DD} is measured in the following pattern.

1. White
2. Yellow
3. Purple
4. Red
5. Light Blue
6. Green
7. Blue
8. Black



Note 2) The Maximum value of I_{DD} is measured in the following pattern.



5. Optical Characteristics

5.1 Test Conditions

It is same as 4.1

The measuring method is shown in 11.

5.2 Optical Specifications [1)]

Item		Symbol	Conditions		Specifications			Unit	Remark
					MIn.	Typ	Max.		
Viewing Angle[2)]		?	*CR*>=10	? = 180?	(30)	(40)	-	?	Define at Contrast Ratio
				? = 0?	(40)	(50)	-	?	
				? = 90?	(40)	(50)	-	?	
				?= -90?	(40)	(50)	-	?	
Contrast Ratio[2)]		*CR*	? =0?, ?=0?		150	(250)	-	-	
Response Time[2)]		$?_r$	? =0?, ?=0?		-	28	50	ms	
		$?_d$			-	10	20	ms	
Transmittance[3)4)]		*TR*	? =0?, ? =0? Gray Scale Level=L63 (White)		7.0	8.2	-	%	
Chromaticity[2)]	Red	x_R	Gray Scale Level:L63		-	(0.60)	-	-	
		y_R	? =0?, ? =0?		-	(0.33)	-	-	
	Green	x_G	Ditto		-	(0.32)	-	-	
		y_G			-	(0.54)	-	-	
	Blue	x_B	Ditto		-	(0.15)	-	-	
		y_B			-	(0.12)	-	-	
	White	x_W	Ditto		-	(0.32)	-	-	
		y_W			-	(0.33)	-	-	

Note 1): Refer to "11. Measuring Method".

Note 2): Optical specification depend on backlight.

These specifications are reference value at the time of using Toshiba Matsushita Display Technology Co., Ltd. original backlight (backlight luminance is 1500 cd/m^2) for LTM15C503-A.

Note 3): This specification is the value at the time of using Toshiba Matsushita Display Technology Co., Ltd. standard light box.

Standard Light Box : Fujicolor Lightbox

Fluorescence lamp : Toshiba-made Mellow 5 (FL10EX-D-H)

Note 4) : Transmittance is depend on spectrum of backlight.

6.Quality

6.1 Inspection AQL

Total of Major Defects : AQL 0.65 %

Total of Minor Defects : AQL 1.5 %

Sampling Method: ANSI/ ASQC Z1.4 (level ll)

6.2 Test Conditions

1) Ambient Temperature : 25?5?C

2) Ambient Humidity : 65?20%(RH)

3) Illumination : Approximately 500 lx under the fluorescent lamp

4) Viewing Distance : Approximately 0.35m by the eyes of the inspector from the module

5) Inspection Angle : ?=0?, ?=0?

6.3 Dimensional Outline

The products shall conform to the dimensions specified in 2.3.2.

Definition of Major and Minor defects are as follows.

Item	Description	Class
Important Dimensions	Dimensional outline	Major
Others	Dimensions specified in this specifications	Minor

6.4 Appearance Test

6.4.1 Test Conditions

1) Condition : Non-operating, operating (Pattern : L63 white raster)

Same as 6.2

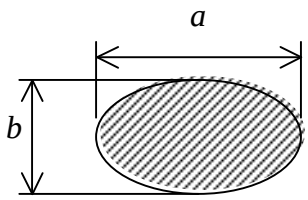
6.4.2 Specifications

<table>
<tr><th>Item</th><th>Description</th><th>Class</th></tr>
<tr><td>PCB Appearance</td><td>Pattern peeling snapping, electrically short</td><td>Major</td></tr>
<tr><td></td><td>Repair portion on PCB is not covered by epoxy resign</td><td>Minor</td></tr>
<tr><td>Soldering</td><td>Cold solder joint, lead move when pulled</td><td>Major</td></tr>
<tr><td>Connectors</td><td>Distinct stain, rust or scratch</td><td>Minor</td></tr>
<tr><td></td><td>
<table>
<tr><th>Line Width(mm)</th><th>Length(mm)</th><th>Acceptable count</th></tr>
<tr><td>W<=0.10</td><td>-</td><td>neglect</td></tr>
<tr><td>0.10<W<=0.15</td><td rowspan="2">L<=3</td><td>n<=8</td></tr>
<tr><td>0.15<W<=0.20</td><td>n<=2</td></tr>
<tr><td>0.20<W</td><td>-</td><td>2)</td></tr>
</table>
<table>
<tr><th>Average diameter(mm)</th><th>Acceptable count/side</th></tr>
<tr><td>D<=0.20</td><td>neglect</td></tr>
<tr><td>0.20<D<=0.50</td><td>n<=5</td></tr>
<tr><td>0.50<D</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>Break and Crack of Panel Outside Edge</td><td>Break : less than 2mm inward from cell outside
Worsening fine crack : reject</td><td>Minor</td></tr>
</table>

Note 1) Inspection area should be within active area.

Note 2) Dusts which are bigger not less than 0.20mm (0.20 ?*W*) shall be judged by "Average Diameter".

Average Diameter $D = (a+b)/2$ (mm)



6.5 Display Quality

6.5.1 Test Conditions

1) Inspection Area : Within active area

2) Driving Condition : Same as test conditions shown in 4.1 and 6.2

3) Test Pattern : White display pattern (gray scale level L63), black display pattern (gray scale level L0), red display pattern (gray scale level L63), green display pattern (gray scale level L63) and blue display pattern (gray scale level L63)

6.5.2 Specifications [4)]

Item	Description / Specifications	Class
Function	No display, Malfunction	Major
Display Quality [1)] ? #	Missing line	Major
	Dot defect except cluster of dot defect : neglect	-
	Various uniformity (mura) : neglect	-
	Inconspicuous flicker, crosstalk, Newton's ring and other defects : neglect	-
Black and White Spots/lines	Inconspicuous defects : neglect	-

Note 1) Inspection area should be within the active area.

Note 2) Bright defect means a bright spot(sub-pixel) on the display pattern of gray scale L0.
Dark defect means a dark spot(sub-pixel) on the display pattern of gray scale L63.

6.6 Reliability Test (Reference)

6.6.1 Test Conditions[3)]

1) The module without backlight should be driven and inspected under normal test conditions.

2) The module without backlight should not have condensation of water (moisture) on the module without backlight.

3) The module without backlight should be inspected after two or more hours storage in normal conditions (15 - 35?C, 45 - 65%(RH)).

4) A module without backlight shall be used only for one test.

6.6.2 Specifications

The module without backlight shall have no failure in the following reliability test items.

Test Item	Test Conditions	Result
High Temperature Operation [1)]	50?C 192 h	3p/3p OK
High Temperature Storage [2)]	60?C 192 h	3p/3p OK
High Temperature and High Humidity operation [1)]	50?C 80% 192 h	3p/3p OK
Low Temperature Operation [1)]	0?C 192 h	3p/3p OK
Low Temperature Storage [2)]	-20?C 192 h	3p/3p OK
Temperature Shock [2)]	-20?C ? 60?C 0.5h 0.5h 50 cycles	3p/3p OK

Note 1) Operating

Note 2) Non-Operating

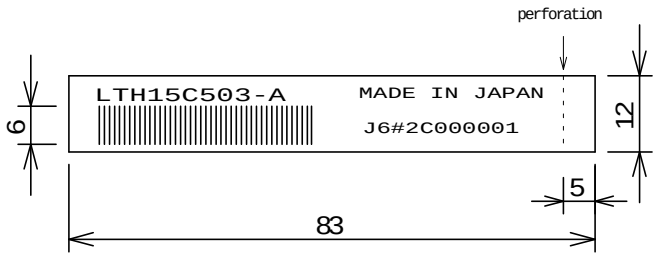
Definitions of failure for judgment shall be as follows:

1) Function of the module without backlight should be maintained.
2) Current consumption should be smaller than the specified value.
3) Appearance and display quality should not have distinguished degradation.

6.7 Labels

(1) Product Label

Unit : mm



Serial number : J6 # 2C 0 00001

✍ ✍ ✍ ✍ ✍

✍ : Module type code

"J6" means "LTH15C503-A".

✍ : Manufacturing code

C,K : MADE IN JAPAN

✍ : Lot code 2 C

(1) (2)

(1):Year code-end of the A.D.

(2):Month code-alphabet✍ Jan. : A - Dec. : L

(Example: 2C✍2002 MAR.)

✍:Revision No.

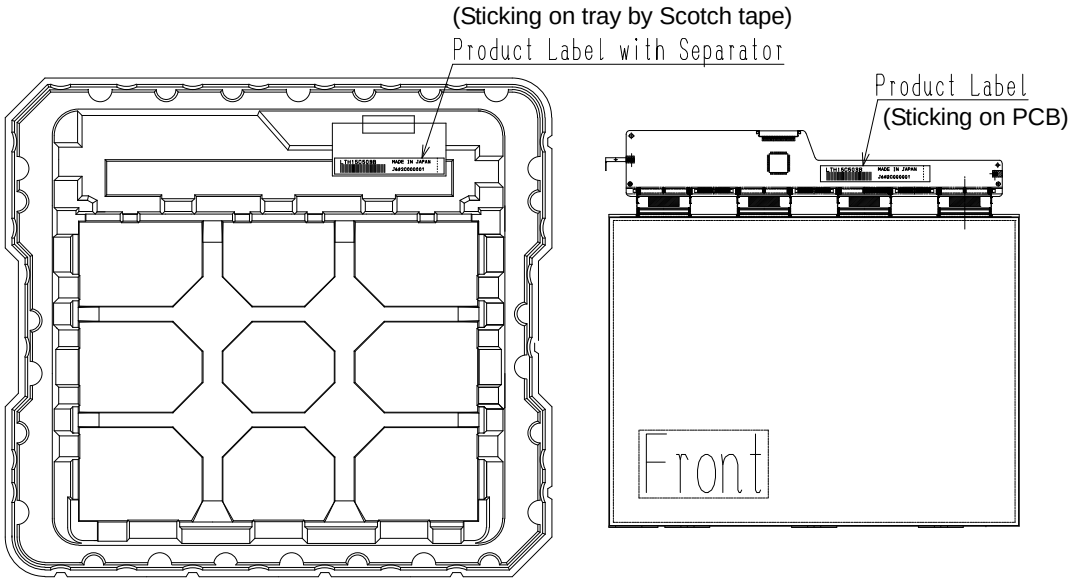
✍: Serial code

decimal, 5 figures

Bar code of serial number : CODE-39 High-density

(2) Label Locations

Product labels are stuck on two position as follows.



7. Lifetime

7.1 Module without backlight

MTTF (Mean Time To Failure) : 50,000 h

(This value is not assurance time but inference value by following conditions.)

Conditions : Ambient temperature : 25?5?C (No wind)

Ambient humidity : 65%(RH)

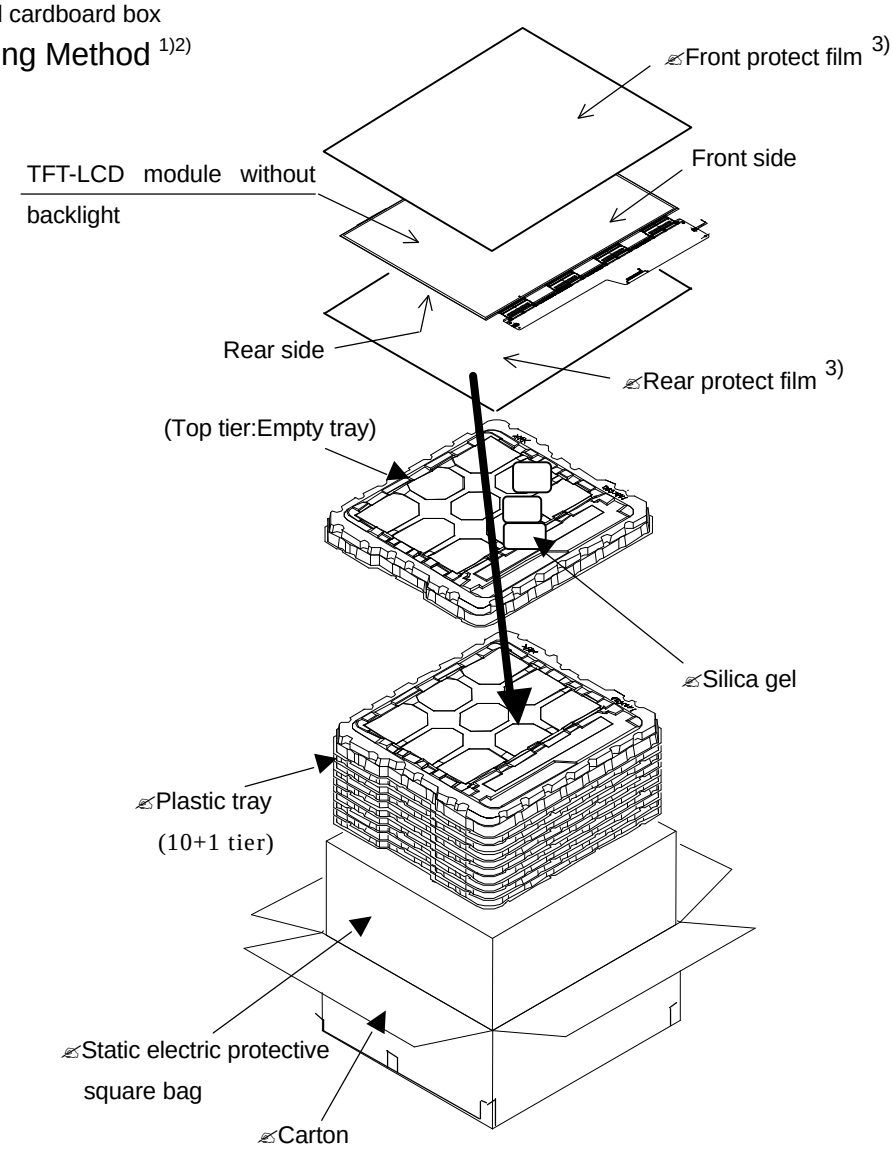
8. Packaging

8.1 Carton (internal package)

(1) Packaging Form

Corrugated cardboard box

(2) Packaging Method [1)2)]

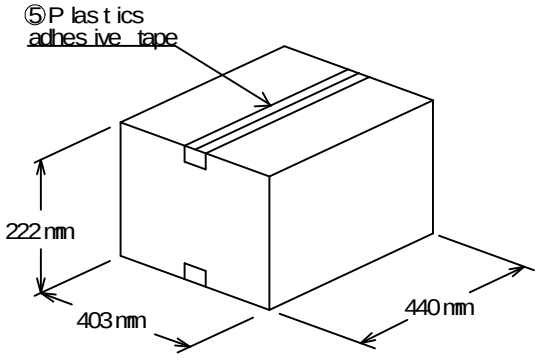


Note 1) Total weight: (Approx.) 5.2 kg

Note 2) Acceptable number of carton piling: 20 sets

(3) Packaging Material

Number	Quantity	Description
✍	11p	Plastic tray
✍	1 set	Static electric Protective square bag
✍	3p	Silica gel(100g?3p)
✍	1set	Carton
✍		Plastics adhesive tape
✍	1sheet	Front protect film[3)]
✍	1sheet	Rear protect film[3)]



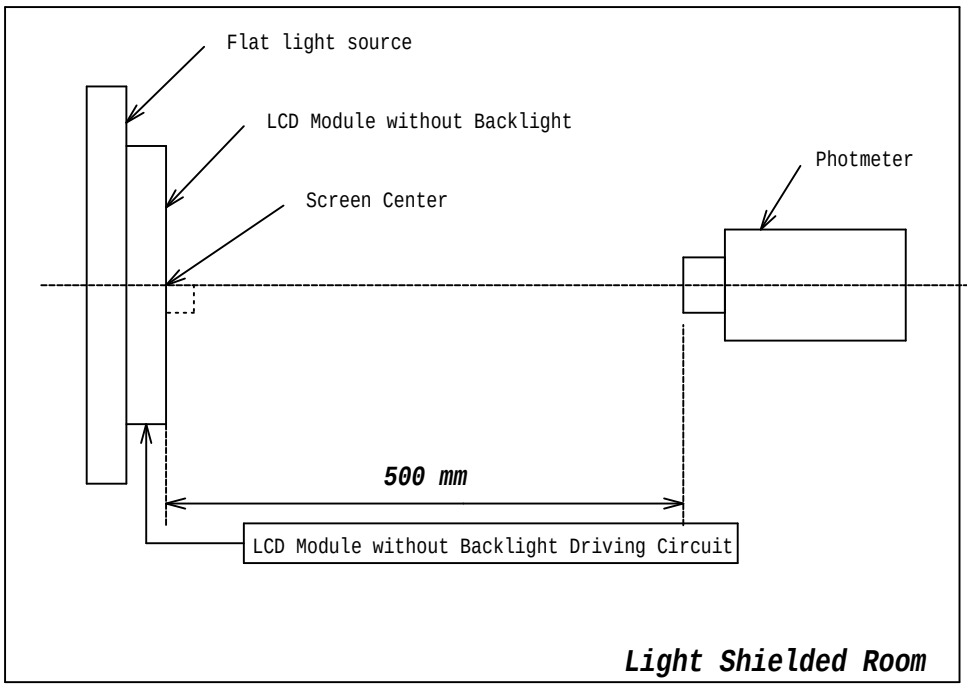
Note 3) There are two kinds of protection files on cell. One is the original protection film of polarizer, the other is the protection film equvalent to it.

9. Warranty

Finish of warranty term is arrival at Action's factory. (except defect which is clearly responsible for Toshiba Matsushita Display Technology Co., Ltd.)

10. Measuring Method

10.1 Measuring System

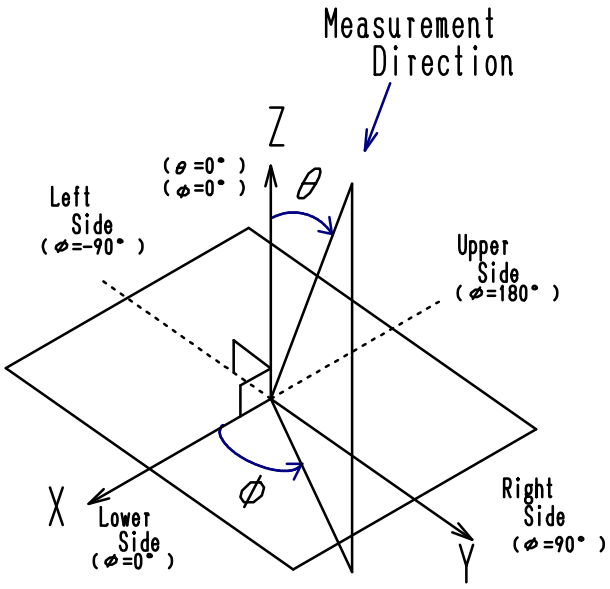


(1) The measurement point is the center of the active area.

(2) Photometer : BM-7/BM-5A TOPCON (Aperture 2deg.)

(3) As flat light source, Toshiba Matsushita Display Technology Co., Ltd. original backlight for LTM15C503-A should be used except for the measurement of transmittance.

(4) Definition of ? and ?:?



10.2 Measuring Methods

(1) Transmittance

The transmittance can be calculated by the following expression.

$$\text{Transmittance } (TR) = \frac{L_{LCD}}{L_{BL}} \times 100\ \%$$

L_{LCD} : Luminance at the time of putting non-operating cell on light box

L_{BL} : Luminance of Toshiba Matsushita Display Technology Co., Ltd. standard light box

Standard Light Box : Fujicolor Lightbox

Fluorescence lamp : Toshiba-made Mellow 5 (FL10EX-D-H)

(2) Contrast Ratio:

The contrast ratio can be calculated by the following expression.

Contrast Ratio (*CR*) = L63 / L0

L63 : Luminance on the white raster (gray scale level L63)

L0 : Luminance on the black raster (gray scale level L0)

(3) Viewing Angle

Viewing angle is defined as the angles(? ,??), in which specified contrast ratio can be obtained.

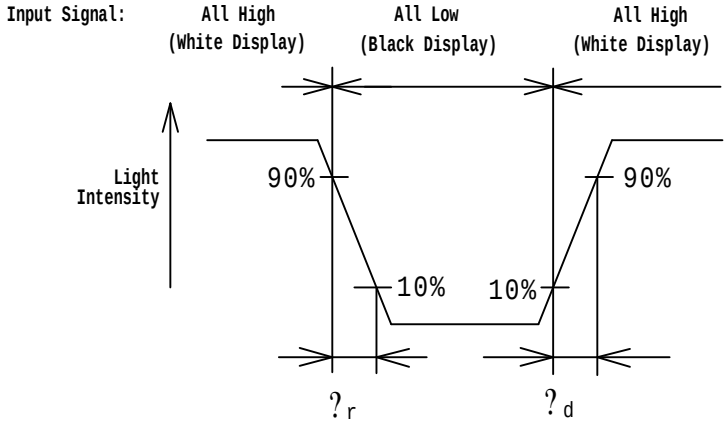
(Refer to 11.1(3) for the axes.)

(4) Chromaticity :

The values(x,y) of chromaticity coordinates should be measured for the White, Red, Green and Blue Raster(gray scale level L63) each with a photometer.

(5) Response Time :

The response time (?r, ?d) is measured with a photo detector (photodiode) which measures the light intensity of the pixels.



?r : Turn on time is the time for a photo detector output waveform to go from 90% value to 10% of its maximum.

?d : Turn off time is the time for a photo detector output waveform to go from 10% to 90% of its maximum.

Photodiode : S1223-01 HAMAMATSU PHOTONICS K.K.

White Display : White Raster (gray scale level L63)

Black Display : Black Raster (gray scale level L0)