TOSHIBA

SPECIFICATION

FOR

TFT-LCD MODULE

LTM12C300

SPECIFICATION No. : LTM12C300

DATE OF ISSUE : 2003-12-20

(DATE OF EXPIRY : 2006-12-19)

Liquid Crystal Module Business Div.

APPROVAL	CONFIRMED	PREPARED

Revision History

Date	Rev.	Sheet (New)	Item	Old	New	Reason
2003-12-20	1	New	-	-	-	-

Toshiba Display Technology Co.,Ltd	Date:2003-12-19　　　New　No. LTM12C300
	Date:　 -　 -　　　　　Old　No.

←# Special　　←& Addution　　← Change

Caution and Handling Precaution

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

For Safety

⚠Warning

(1) Toshiba Technology's Standard LCD modules 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 handing LCD module

DO NOT TOUCH the parts inside LCD module and the flourescent lamp's (hereinafter called "FL") connector or cable in order to prevent electric shock,because high voltage is supplied to these parts from the inverter unit while power supply is turned on.

(3) Make sure to insert the module FL connector to the inverter connector in correct position.

Do not insert in irregular position.

If incorrect,this may cause smoke or burn of electrical parts by high voltage of FL circuit.

If there is a possibility that the connector has been inserted incorrectly, please re-insert the connector only after you confirm the module and FL power is completely off.

DO NOT USE the mating FL connector which Toshiba Technology does not specify.Otherwise, Toshiba Technology shall not be liable for any damages caused by the connector.

⚠Caution

(1) DO NOT DISASSEMBLE OR MODIFY the module.

Sensitive parts inside LCD module may be damaged,and dusts or scratches may mar the displays.

Toshiba Technology does not warrant the module,if customer

disassembled or modified them.

Σ(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.

Σ(3) BE CAREFUL WITH CHIPS OF GLASS that may cause injuring finers or skin,when the glass is broken.

(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 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.

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(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 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 and its peripheral devices before current limiter of the module when open-short test of the module 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 Syetem

(1) LCD module should be assembled to the system by using all mounting holes specified in this specification ane with the specified screws.

(2) Power supply lines should be designed as follows.

Power supply 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 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) DO NOT GIVE high voltage to "Low Voltage"side of the FL.

For example ,DO NOT USE a floating inverter which gives high voltage to "Low Voltage" side.That's because it has a possibility to burn or smoke around FL.

(4) Make sure to connect correctly high-voltage wire and low-voltage wire between FL tube and inverter unit.

(5) Input FL starting voltage (V_{SFL})should not be less than one second.

If it were less than one second ,it may cause unstable operation of FL.

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 is recommended to apply in order to prevent scratches, and invasion of dust, water, etc., from the system's window onto LCD module .

Uitra-violet ray cut filter is recommended to apply onto LCD module 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.

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For Installation in Assembly

   (1) The C-MOS LSIs used in LCD module are very sensitive to ESD (Electro-static Discharge).
        Ambient humidity of working area is recommended to be higher than 50%(RH).
        Person handing LCD module 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 0.5-1MΩ 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.

Σ(4) When LCD panel becomes dirty, wipe off the panel surface 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.

Σ(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.

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

Σ(7) DO NOT APPLY MECHANICAL FORCES.
        Do not bend or twist LCD module even momentary when LCD module is installed an
        enclosure of the system. Bending or twisting LCD module may cause its damages.
        Make sure to design the enclosure that bending/twisting forces are not applied to LCD module 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.

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

Σ(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 and
        the enclosure.
        Make sure to insert the module FL connector to the inverter connector in correct position.
        If incorrect ,this may cause smoke or burn of electrical parts by high voltage of FL circuit.

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1. Scope

This specification is applicable to Toshiba DisplayTechnology's 31cm diagonal size TFT-LCD module "LTM12C300"designed for Personal Computer.

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-,
	   IN0+,IN0-,IN1+,IN1-,IN2+,IN2-

Active Area	245.67 (W) X 184.32 (H)(mm)
Bezel Open	250.4 (W) X 188.9 (H)(mm)
Number of Pixels	1024 (W) X 768 (H)[1]
Pixel Pitch	0.240(W) x 0.240(H) (mm)[1]
Pixel Arrangement	RGB vertical stripes[1]
Surface Treatment	Anti-glare and hard coat 2H on LCD surface
Backlight	Double cold-cathode fluorescent lamp for sidelighting
Dimensional Outline	261.6(W) x 202.8(H) x 9.9(D)(mm)

Note 1)
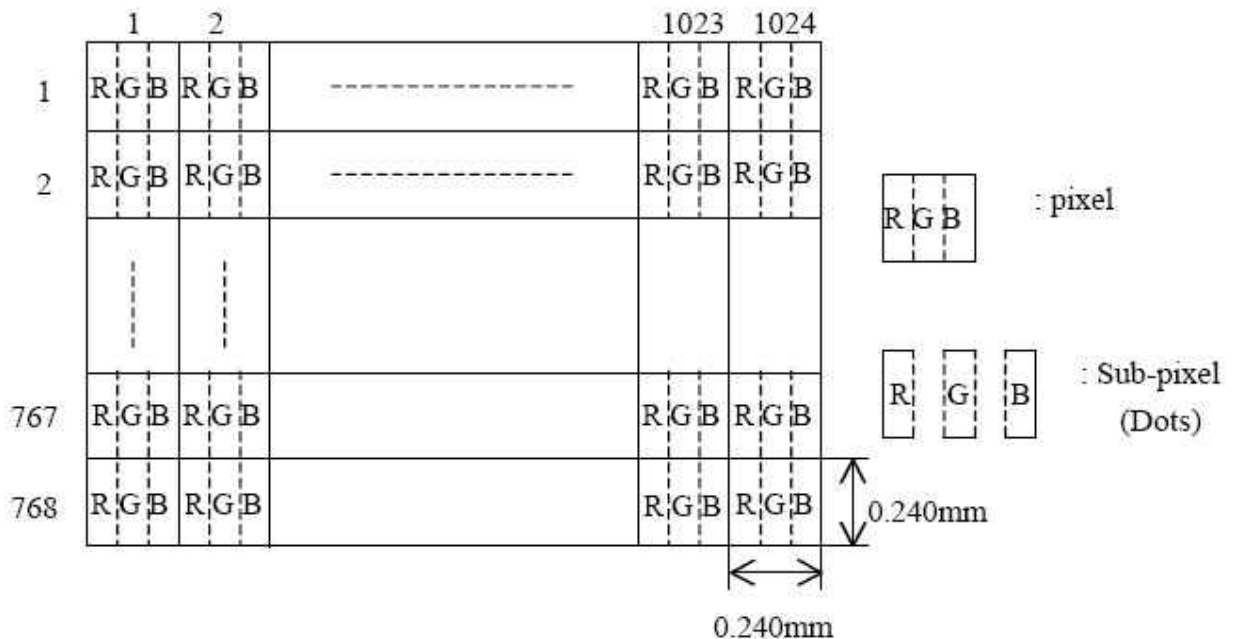
2.2 Absolute Maximum Ratings [1]

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
FL Driving Voltage	V_{FL}	-	2	kV	
FL Driving Frequency	f_{FL}	0	100	kHz	
Operating Ambient Temperature[2]	T_{OP}	0	+50	℃	
Operating Ambient Humidity [2]	H_{OP}	10	90	%(RH)	
Storage Temperature [2]	T_{STG}	-20	+60	℃	
Storage Humidity [2]	H_{STG}	10	90	%(RH)	
Operating Temperature for Panel [3]	-	0	+60	℃	

Note 1) Do not exceed the maximun 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.

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

Note 3)   The surface temperature causeed by self heat radiation of cell itself is specifiedon this item

Note 4)   Refer to 2.4.5
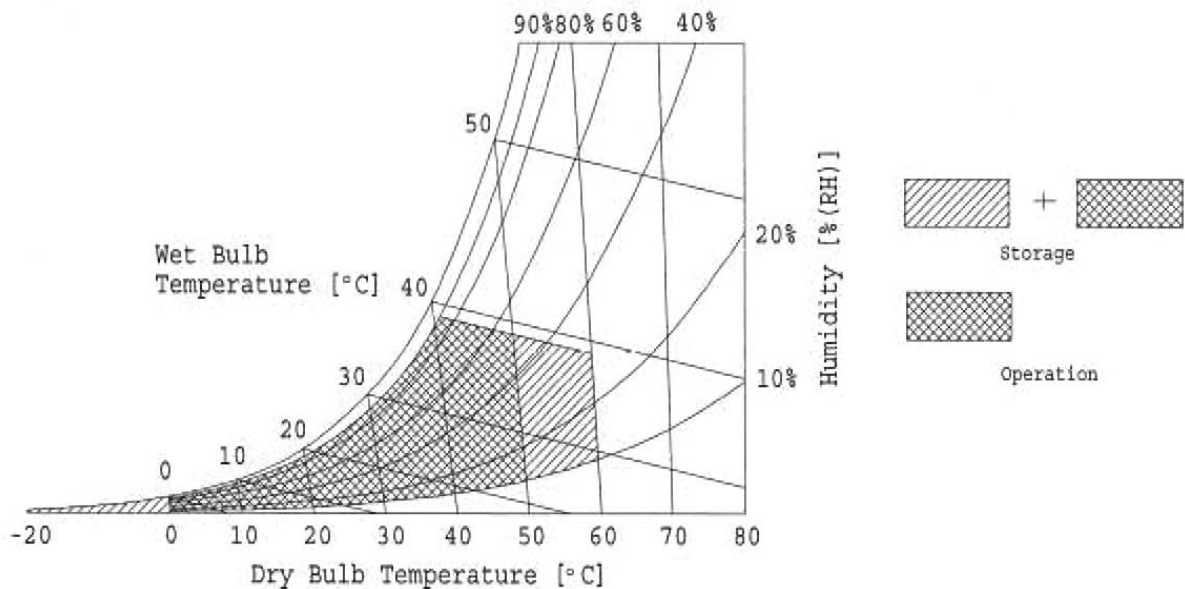
2.3 Mechanical Specifications
2.3.1 Weight

LCD Module : 584±20(g)

2.3.2 Dimensional Outline   **U**nit : mm
(front figure)   Standard Tolerance : ±0.5

170,00   14,50   4,40
9,90±0,3

202,80±0.3
188,90(Frame window)   5,05
184,32(Active area)
6,5
99,50

CN2 BHSR−02VS−1(JST)

131,70

250,40(Frame window)
245,76(Active area)
261,60±0.3

131,9±0.5

12TMBL400
CELL12.Toshiba LTD121LA3SG

Active area CENTER

170,00   14,50

Unit : mm

(back figure)   Standard Tolerance : 0.5

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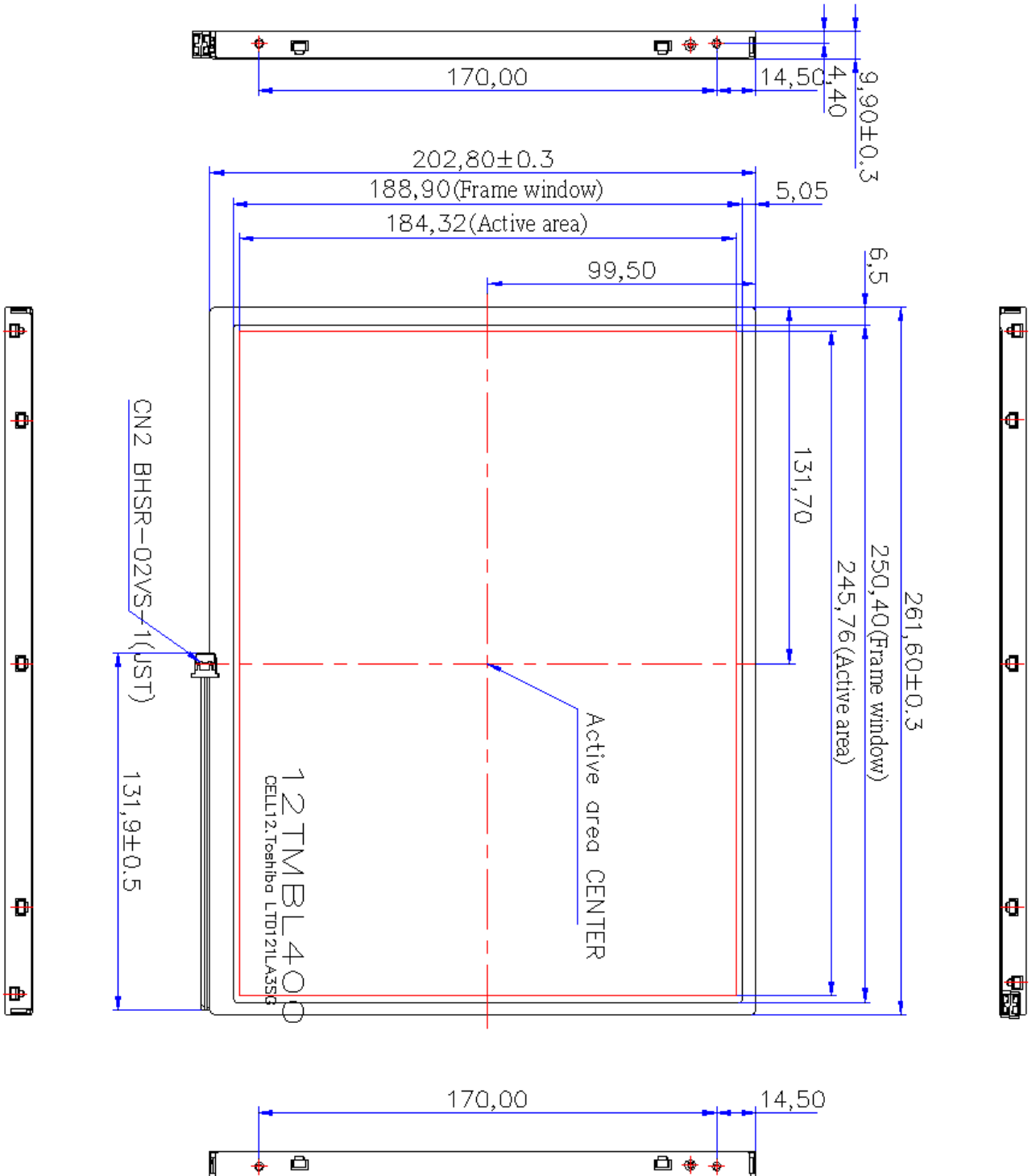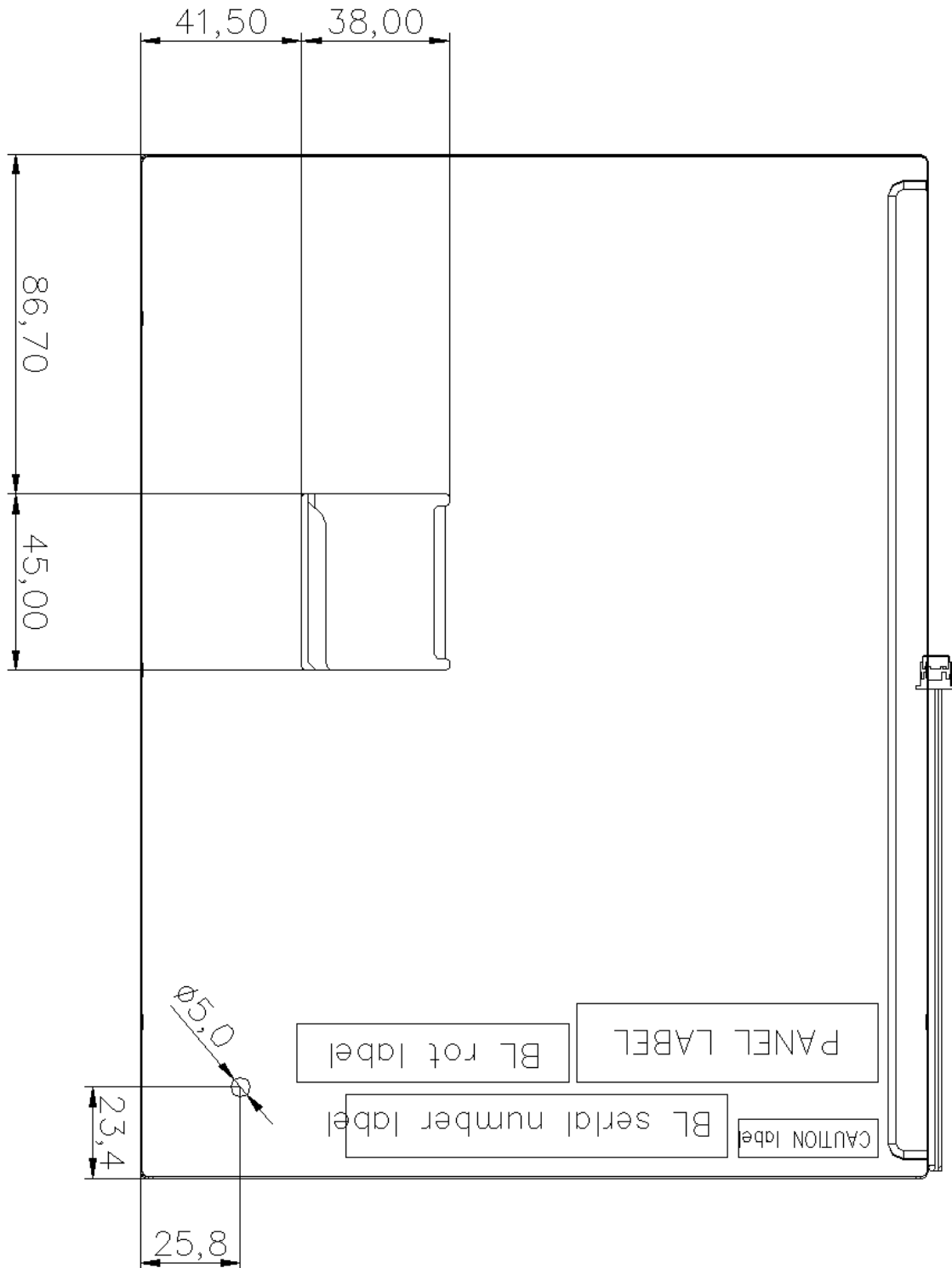
2.4 Electrical Specifications

2.4.1 Circuit Diagram
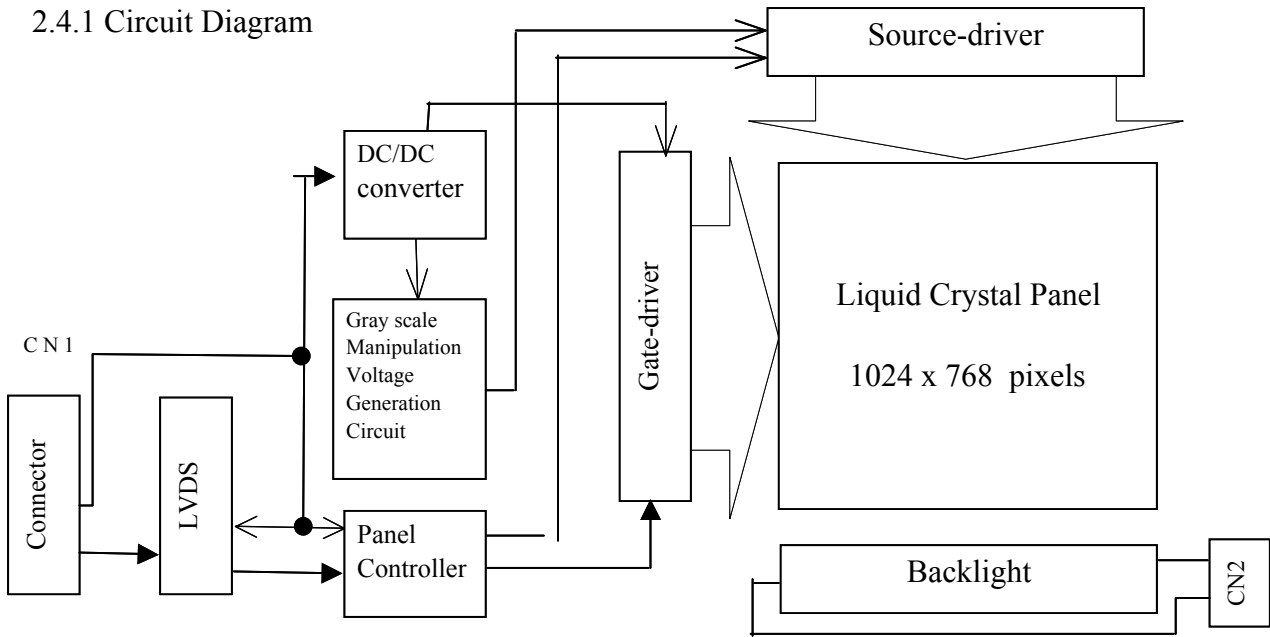
2.4.2 Sequence of Power Supplies and Signals

2.4.3 Timing Chart

2.4.4 Timing Specifications ^{1) 2) 3) 4) 5) 6)7)}

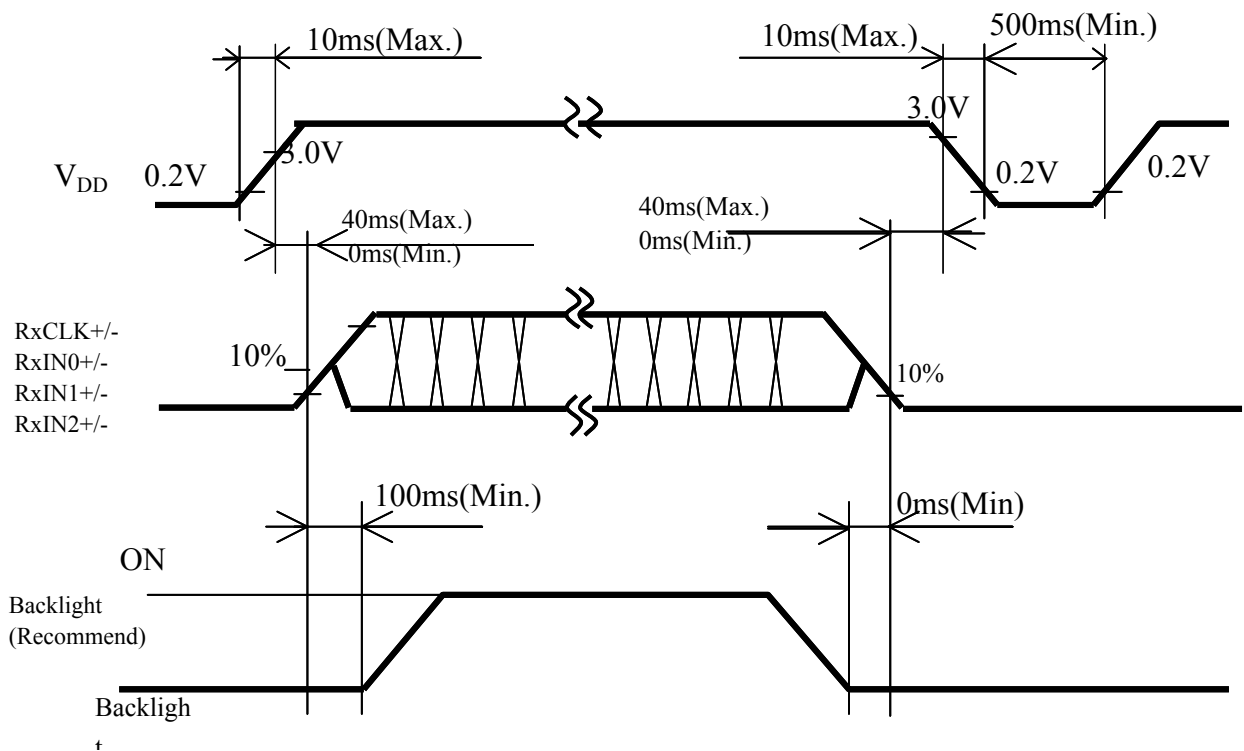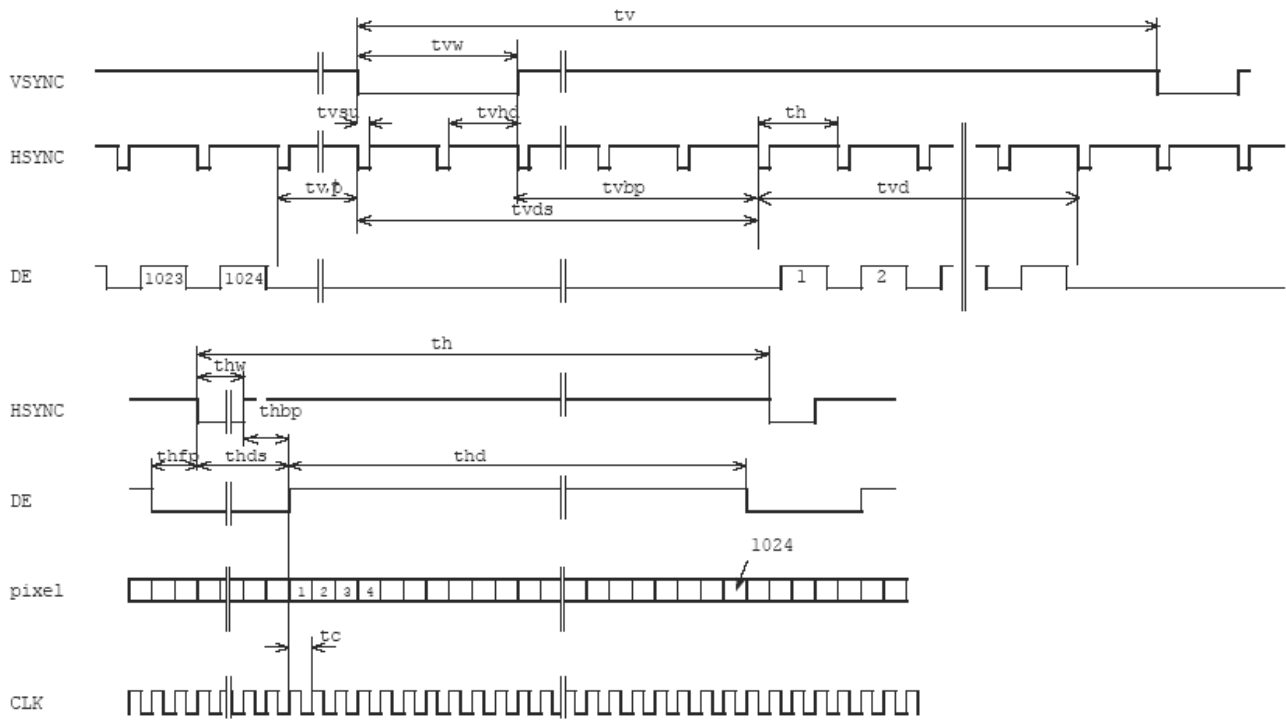| Item	Symbool	mmin.	typ.	max.	unit
Horizontal Scanning Term	th	1334xtc	1344xtc	-	clock
H-sync PulSe Width	thw	4xtc	136xtc	–	clock
Horizontal Front Porch	thfp	4x tc	24x tc	–	clock
Horizontal back Porch	thfp	24x tc	160xx tc	–	clock
Horizontal Data Sync Period	thds	32x tc	32x tc	-	clock
Horizontal Display Terrm	thd	1024x tc	1024x tc	1024x tc	clock
Frame Period	tv	-	806x th	-	line
Frame Frequency	1/tv	60	60	60	HZ
V-sync Pulse Width	tvvw	2 x th	6x th	–	line
V-sync Set Up Time(to H-sync)	tvsu	8x tc	-	-	clock
V-sync Hold Time	tvhd	(thbp+16)x tc		-	clock
Vertical Front Porch	tvfp	1 x th	3x th	-	line
Verrtical Back Porch	tvbp	2 x th	29xx th	–	line
Vertical Data Sync Period	tvds	8x th	35x th	–	line
Vertical Display Terrm	tvd	768x th	768x th	768x th	line
Clock Period	Tc	15.0	15.38	-	ns

Note 1) Refer to "2.4.3Timing Chart".

Note 2) If ENAB is fixed to "H" or "L" level for certain period while NCLK is supplied, the panel displays black with
      some flicker.

Note 3) If NCLK is fixed to"H" or "L" level for certain period while V_{DD} is supplied, the panel may be damaged.

Note 4) 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 (especically driving frequency), even if the condition satisfies above timing specification
      and recommended operating condition shown in 3.

Note 5) Do not make *tv ,tvhd* and tvds fluctuate.
      If *tv,tvhd* ,and *tvds* are fluctuate, the panel displays black.

Note 6) In case of using the long frame periodthe deterioration of display quality,noise etc.may be occurred.

Note 7) 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: DF19L-20P-1H/Hirose Electric Co.,Ltd

    Mating Connector:DF19G-20S-1C(Cable Type),DF19G-20S-1F(Fpc Type)/Hirose Electric Co.,Ltd

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	V_{SS}	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 to ground.Don't use it as no-connect nor connection with high impedance.
Note 2) 262,144 colors are displayed by the combinations of 18 bits data.(see next page)

CN2 CCFL POWER SOURCE

    Connector : BHSR-02VS-1
    Mating Connetor: SM02B-BHS-1

Terminal No.	Symbol	Function
1	V_{FLH}	CCFL Power Supply (high voltage)
2	V_{FLL}	CCFL Power Supply (low voltage)

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RECOMMENDED TRANSMITER (THC63LVDF63A,THC63LVDM63A,THC63LVDM63A-85) TO LTM12C300 INTERFACE ASSIGNMENT

Case1 :　6Bit Transmitter

Input Terminal No.		Input Signal (Graphics controller output signal)		Output Signal Symbol	To LTM12C300 Interface(CN1)	
Symbol	Terminal	Symbol	Function		Terminal	Symbol
TA0	44	R0	Red Pixels Display Data (LSB)	TA- TA+	No.5 N0.6	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 N0.9	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 N0.12	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 Synchronized Signal			
TC5	23	VSYNC	Vertical Synchronized Signal			
TC6	25	DE	Compound Synchronization Signal			
TCLK IN	26	CLK	Date Sampling Clock	TCLK- TCLK+	No.14 N0.15	CLK- CLK+
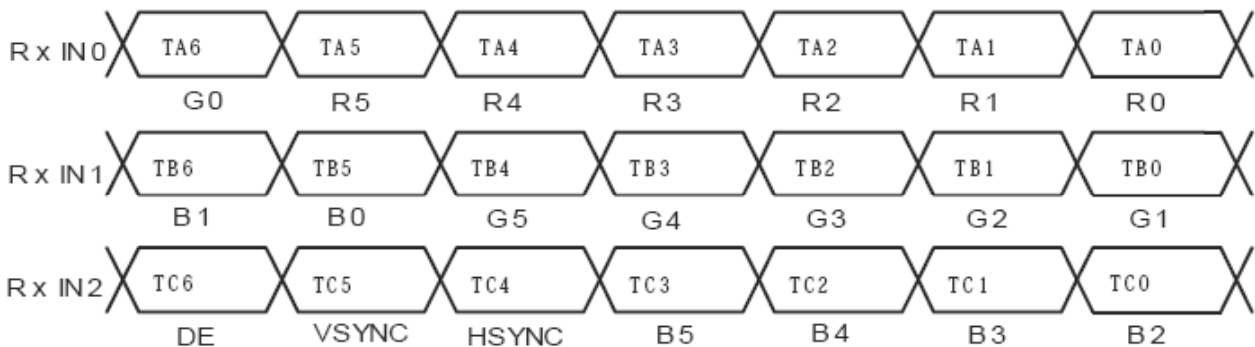
RECOMMENDED TRANSMTTER (THC63LVDF63A,THC63LVDM83A,THC63LVDM83A-85) TO LTM12C300 INTERFACE ASSIGNMENT

Case 2: 8Bit Transmitter

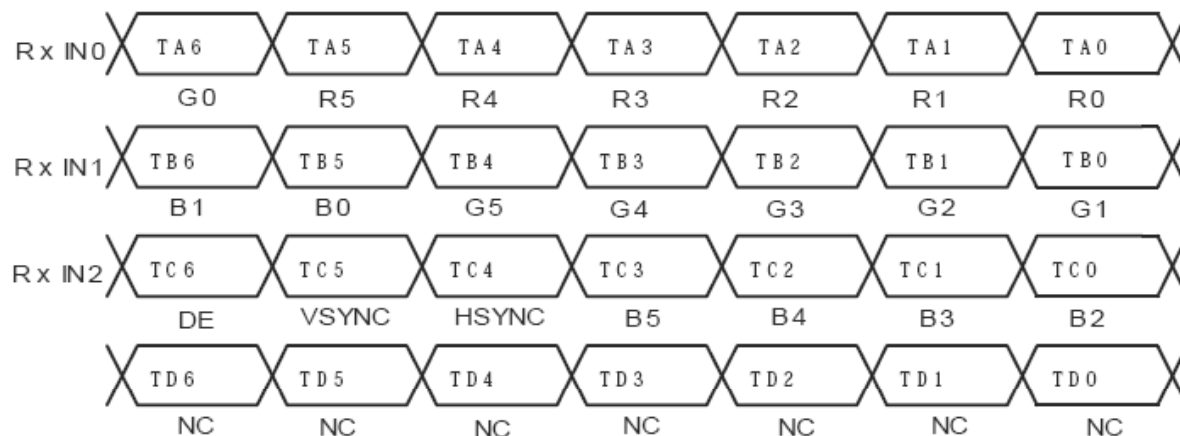| Input Terminal No.		Input Signal Graphics controller output signal		Output Signal Symbol	To LTM12C300 Interface(CN1)	
Symbol		Symbol	Function		Terminal	Symbol
TA0	51	R0	Red Pixels Display Data (LSB)			
TA1	52	R1	Red Pixels Display Data			
TA2	54	R2	Red Pixels Display Data	TA-	No.5	RxIN0-
TA3	55	R3	Red Pixels Display Data	TA+	N0.6	RxIN0+
TA4	56	R4	Red Pixels Display Data			
TA5	3	R5	Red Pixels Display Data (MSB)			
TA6	4	G0	Green Pixels Display Data			
TB0	6	G1	Green Pixels Display Data			
TB1	7	G2	Green Pixels Display Data			
TB2	11	G3	Green Pixels Display Data	TB-	No.8	RxIN1-
TB3	12	G4	Green Pixels Display Data	TB+	N0.9	RxIN1+
TB4	14	G5	Green Pixels Display Data (MSB)			
TB5	15	B0	Blue Pixels Display Data (LSB)			
TB6	19	B1	Blue Pixels Display Data (LSB)			
TC0	20	B2	Blue Pixels Display Data			
TC1	22	B3	Blue Pixels Display Data			
TC2	23	B4	Blue Pixels Display Data	TC-	No.11	RxIN2-
TC3	24	B5	Blue Pixels Display Data (MSB)	TC+	N0.12	RxIN2+
TC4	27	HSYNC	H-SYNC			
TC5	28	VSYNC	V-SYNC			
TC6	30	DE	Compound Synchronization Signal			
TD0	50	NC	Non Connection (Open)			
TD1	2	NC	Non Connection (Open)			
TD2	8	NC	Non Connection (Open)	TD-	-	-
TD3	10	NC	Non Connection (Open)	TD+	-	-
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 N0.15	CLK- CLK+

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2.4.6 Colors Combination Table

	Display	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	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	L0
	Dark	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L1
↑		L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L2
↓		:						:						:						L3… L60
Light		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	L0
	Dark	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L1
↑		L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L2
↓		:						:						:						L3… L60
Light		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	L0
	Dark	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L1
↑		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L2
↓		:						:						:						L3… L60
Light		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	L0
	Dark	L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L1
↑		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L	L2
↓		:						:						:						L3… L60
Light		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

Note 1 L:Low level voltage, H:High level voltage

---

3. Recommended Operating Conditions[1)2)3)9)]

Item	Symbol	Min	Typ	Max	Unit	Remarks
Supply Voltage [3)]	V_{DD}	3.0	3.3	3.6	V	
Differential Input Amplitude Voltage	V_{ID}	100.0	---	600	mV	4)
Common mode Voltage	V_{CM}	1.0	---	$2.4-V_{ID}/2$	V	4)
FL Input Current [5)6)7)]	I_{FL}	2.0	6.0	6.5	mA(rms)	
FL Driving Voltage [5)]	V_{FL}	690	740	790	V(rms)	I_{FL}=6.0mA(rms)
FL Driving Frequency [5)9)]	f_{FL}	50	55	60	kHz	
FL Starting Voltage [5)8)]	V_{SFL}	950	---	1100	V(rms)	0℃

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

Note 2) Recommended LVDS transmitter :THC63LVDF63A,THC63LVDM63A,THC63LVDM63A85,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 :Vdd, GND   (GND :Vss=0V)

Note 4) Checked Pin Terminal :IN0_,CLK+, GND (0V)

Note 5) Checked Pin Terminal:V_{FLH}-$V_{FLL.}$

Note 6) If FL input current (I_{FL}) is higher than typical value(6.0mA(rms)),then FL lifetime becomes shorter.
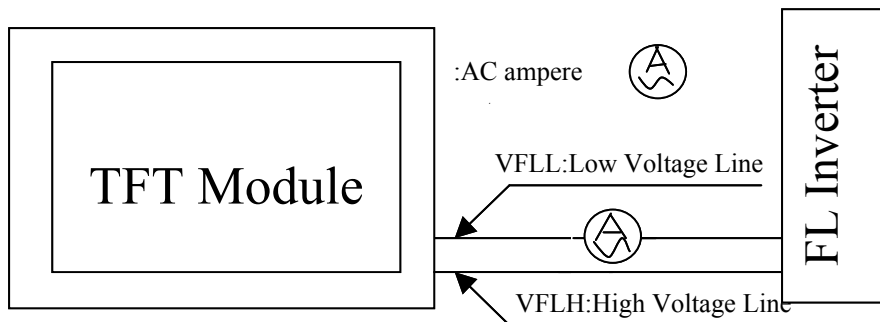
Note 7) Measuring Method of I_{FL}

Note 8) Input FL starting voltage (V_{SFL}) should not be less than one second.
If it were less than one second, it may cause unstable operation of FL.

Note 9) 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 drving frequency),even if the condition satisfies above recommended operating condditions and timing specifications shown 2.4.4.

TFT Module   :AC ampere   FL Inverter

VFLL:Low Voltage Line

VFLH:High Voltage Line

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4.Electrical Characteristics

4.1Test Conditions

Ambient Temperature   : Ta   25±5℃

Ambient Humidity   : Ha   65±20%(RH)

Supply Voltage   : V_{DD} 3.3V

Input Singal   : Refer typical value om "2.4.4 Timing Specifications".

FL Input Current   : I_{FL} =6.0mA(rms)

FL Driving Frequency   : f_{FL} =50k Hz

4.2 Specifications

Item	Symbol	Min.	Typ.[1]	Max.	Unit	Remark
Current Consumption	I_{DD}	-	225		mA	V_{DD} Terminal Current

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

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

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		θ	CR>=10	$\phi = 180^{o}$	70	75	-	o	Define at
				$\phi = 0^{o}$	70	75	-	o	Contrast Ratio
				$\phi = 90^{o}$	60	65	-	o	
				$\phi = -90^{o}$	60	65	-	o	
Contrast Ratio		CR	$\theta = 0^{o}$, $\phi = 0^{o}$		300	-	-	-	
Response Time		t_{ON}	$\theta = 0^{o}$, $\phi = 0^{o}$		-	-	50	ms	
		t_{OFF}			-	-	50	ms	
Luminance		L	$\theta = 0^{o}$, $\phi = 0^{o}$ Gray Scale Level=L63(White)		-	400	-	cd/m^2	I_{FL}=6.0mA(rms)
Chromaticity	Red	X_{R}	Gray Scale Level :L63		-	0.58	-	-	
		Y_{R}	$\theta = 0^{o}$, $\phi = 0^{o}$		-	0.33	-	-	
	Green	X_{G}	Ditto		-	0.32	-	-	
		Y_{G}			-	0.53	-	-	
	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) The above test limit must be applied for initial use. Characteristics will be shifted by long period operation, but it is not irregular phenomena. Theoretically brightness characteristics will be decreased due to CCFL degradation and color shift due to optical components change.

6.Quality

6.1 Inspection AQL

Total of Major Defects: QL 0.65%

Total of Major Desects: QL 1.5%

Sampling Method:ANSI/ASQCZ 1.4(level II)

6.2 Test Conditions

1)Ambient Temperature   : $25 \pm 5\,°\text{C}$

2)Ambient Humidity   : 65±20%(RH)

3)Lumination   : 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   : $\theta=0°,\psi=0°$

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

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6.4 Appearance Test
6.4.1 Test Conditions
1) Condition : Non-operating ,operating (Pattern : L63 white raster)

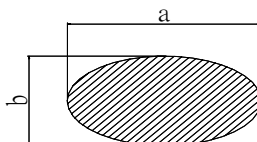Same as 6.2

6.4.2 Specifications

Item	Description	Class
PCB Appearance	Pattern peeling snapping, electrically short Repair portion on PCB is not covered by epoxy resign	Major
Soldering	Cold solder joint, lead move when pulled	Minor
Bezel, Frame, Connectors	Distinct stain, rust or scratch	Major
Black and White Spots/Lines		Minor

Line Width(mm)	Length(mm)	Acceptable count
W<=0.10		neglect
0.10<W<=0.15		n<=8
0.15<W<=0.20	L<=10	n<=2
0.20<W		3)

Average diameter(mm)	Acceptable count/side
D<=0.20	neglect
0.20<D<=0.50	n<=5
0.50<D<=1.50	n<=2
1.50<D	0

Note 1) Inspection area should be within active area.

Note 2) Black/White Spot,Polarizer Dents and Polarizer Bubble shall be judged by "Average Diameter".

Note 3) 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)

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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	Missing line	Major

	Missing Sub-Pixels
	
	  1) Bright defects　　　　　　: 15pcs. maximum
	
	  2) Dark defects　　　　　　　: 15pcs. maximum
	
	  3) Total sub-pixel defects　　 : 20pcs. maximum
		Minor

	Various uniformity (mura) : neglect	-
	Inconspicuous flicker, crosstalk, Newton's ring and other defects : neglect	-
Black and White Spots/lines	Inconspicuous defects : neglect	-
Backlight	Missing (Non-operating)	Major

Note 1) Defects of both color filter and black matrix are counted as bright or dark defects.
    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.

Note 3) Bright defect which can not be found by using 5%ND-Filter shall not be counted as a defect.

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6.6 Reliability Test

6.6.1 Test Conditions[3]

1) The module should be driven and inspected under normal test conditions.

2) The module should not have condensation of water (moisture) on the module

3) The module should be inspected after two or more hours storage in normal conditions (15 - 35℃, 45 - 65%(RH)).

4) A module shall be used only for one test.

6.6.2 Specifications

The module shall have no failure in the following reliability test items.

Test Item	Test Conditions	Result
High Temperature Operation [1]	50℃ 192h	3p/3p OK
High Temperature Storage [2]	60℃ 192h	3p/3p OK
High Temperature and High Humidity Operation [1]	50℃ 80% 192h	3p/3p OK
Low Temperature Operation [1]	0℃ 192h	3p/3p OK
Low Temperature Storage [2]	-20℃ 192h	3p/3p OK
Temperature Shock [2]	-20℃ ◄► 60℃ 0.5h 0.5h 50 cycles	3p/3p OK
Mechanical Vibration [2]	10-200-10Hz sweep/cycle $1.5 \times 9.8 m/s^2$ Constant, X,Y,Zeach direction,0.5h each	3p/3p OK
Mechanical Shock [2]	$50 \times 9.8 m/s^2$,20ms, ±X,±Y,±Z each direction, one time each	3p/3p OK

Note 1) Operating

Note 2) Non-Operating

Definitions of failure for judgment shall be as follows:

1) Function of the module should be maintained.

2) Current consumption should be smaller than the specified value.

3) Appearance and display quality should not have distinguished degradation.

4) Luminance should be large than 50%of the minimum value specificed in 5.2

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7.Lifetime
7.1 Module (except lamp)

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

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

Conditions : Ambient temperature   : 25±5℃(NO WIND)

Ambient humidity   : 65%(RH)

7.2 Lamp
7.2.1 Test Conditions

Ambient temperature   : 25±5℃(No wind)
Lamp current   : 6.0mA(rms)
Lighting condiction   : continuous lighting
Driving frequency   : 50kHz

7.2.2 Specification

MTBF :10,000 h
Definitions of failure for judgment shall be as follows.
1)LCD luminance becomes half of the minimum value specication in 5.2
2)Lamp doesn't light normally

Note 1): In case of LCD long period operation,discoloration of light guide or optical sheet will be happened due to ultra
violet and heat from CCFL. As the result,there is possibility to have out of specification for the optical
characterisitics as "5.2" But this is not irregular phenomena,CCFL also has the characteristic of color shift by long
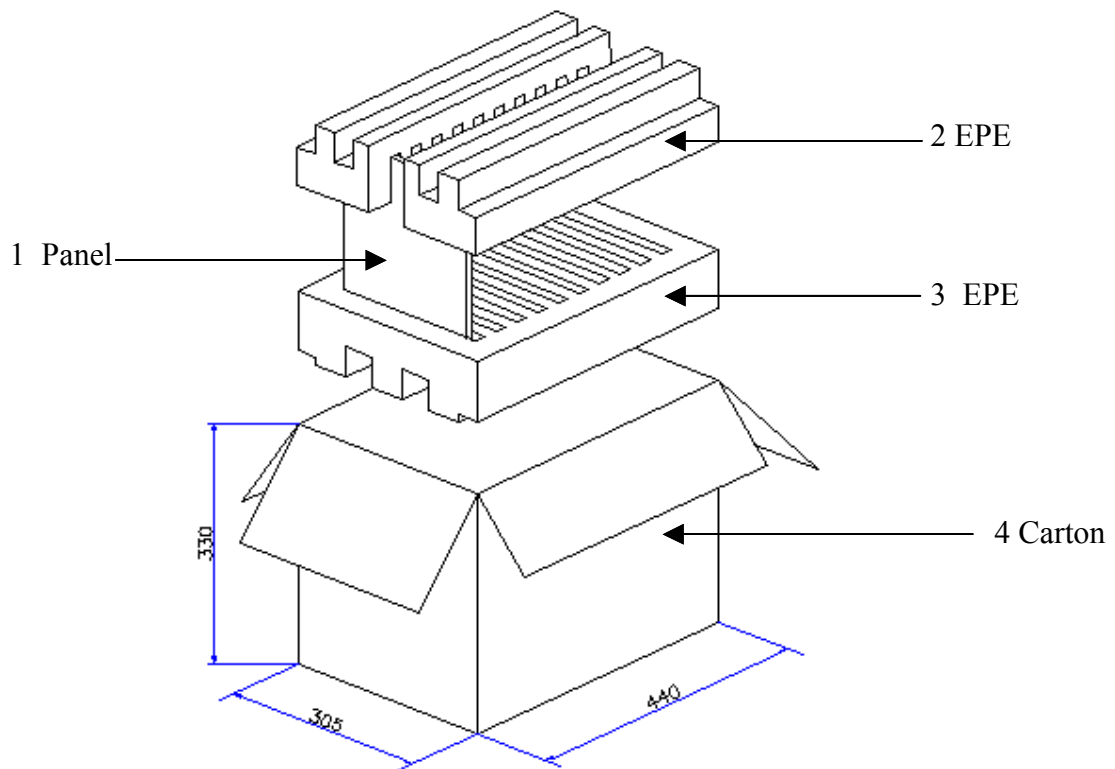period operation.

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8.Packaging

      8.1 Carton(internal package)

      (1)Packaging Form

         Corrugated cardboard box

      (2) Packaging Method

1 Panel

2 EPE

3 EPE

4 Carton

330

305

440

Unit : mm

Note 1) Total weight : (Approx.) 7.0 kg

Note 2) Acceptable number of piling : 5 sets

Number	Quantity
1	5
2	2
3	1
4	1

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9. Warranty

Finish of warranty is arrival at your factory.(expect defect which is clearly responsible for Toshiba Technology

10.Regulation

The set (which our LCD module is assembled into) to conform the regulations below,take measures in set side.
Toshiba Technology is not liable for the regulations to the complete set,nor can guarantee our LCD module
conform the regulation by itself.

       a) Examples of EMI Regulations
               FCC   :PART15 CLASS B
               VCCI   : CLASS B
               CISPR   :CLASS B

       b) Examples of Safety Regulations
               IEC   950
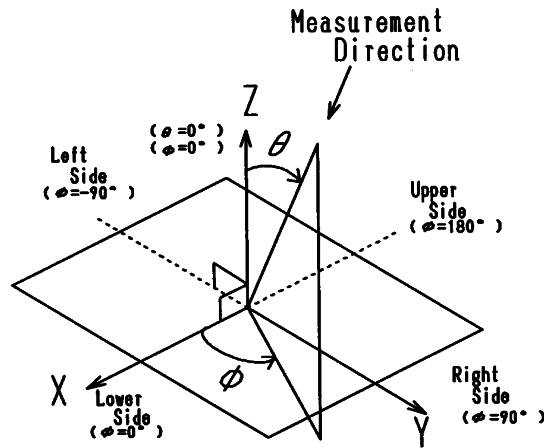   UL   1950

11. Measuring   Method
11.1 Measuring System
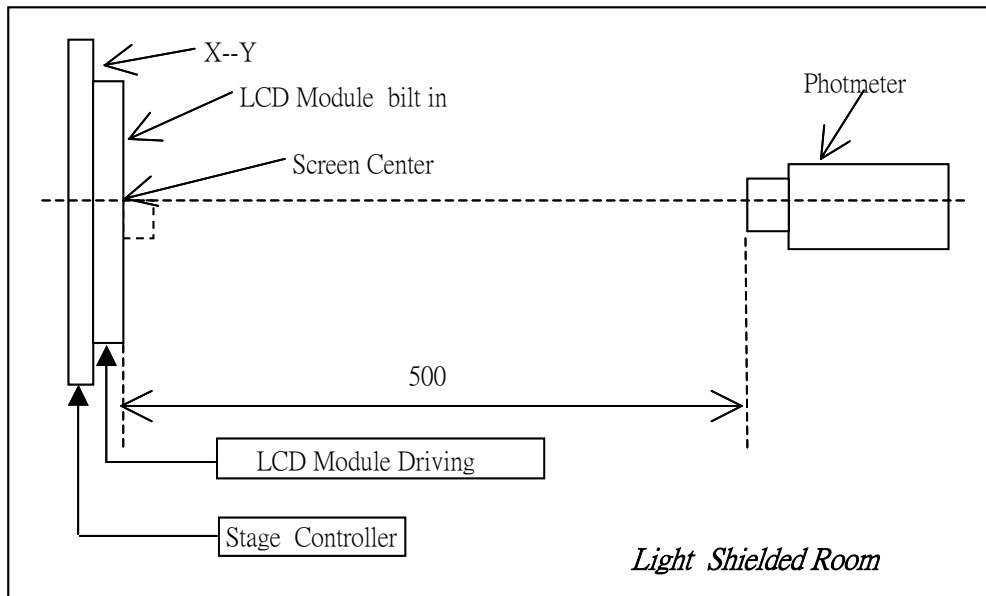
(1) The measurement point is the center of the active area except for the measurement of Luminance Uniformity
(2) Photometer :BM-5A/BM-7 TOPCON (Aperture 2deg.)

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(3) Definition of Φ and θ

11.2 Measuring Methods

(1) Luminance:
   The luminance of the center on a while raster (gray scale level L63)shall be measured.
   Measurement shall be executed 30 minutes after the lamp is lit up.

(2) Contrast Ratio:
   The contrast ratio can be caculated by the following expression.
             Contrast Ratio (CR)=L63/L0
          L63:Luminance on the white raster (gray scale level L63)
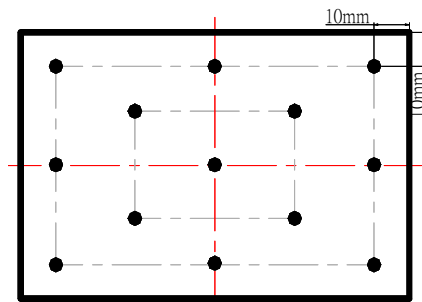   L 0:Luminance on the black raster (gray scale level L0)

(3) Viewing Angle
    Viewing angle is defined as the angles(Φ ,θ),in which specified contrast ratio can be obtained.
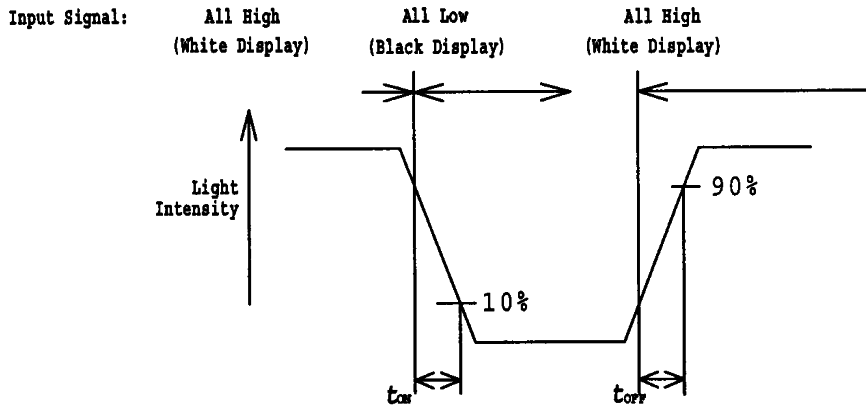   (Refer k to 11.1(3) for the axes.)

(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

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(5) Response Time:

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

```
Input Signal:    All High        All Low        All High
                (White Display)  (Black Display) (White Display)
```


tON   : Turn on time is the time for a photo detector output waveform to go from maximun value to 10% of its maximun.

tOFF : Turn off time is the time for a photo detector output waveform to go from zero to 90% of its maximun.

Photodiode   : S1223-01 HAMAMATSU PHOTONICS K.K
White Display : White Raster(gray scale level L63)
Black Display : Black Raster (gray scale level L0)

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