

Material List of LTM12C275C/A

Parts name	Generic name		Manufacturer		Type No.	Flame class	UL file No.		
TAB-IC	Base film		UBE INDUSTRIES LTD.		(c)s#	94VTM-0	E48133		
PCB	PWB	I/F.-PCB	Product	SHINKO SEISAKUSHO LTD.	711V	94V-0	E46669		
			Material	MITSUBISHI GAS CHEMICAL CO.,INC.	CCL-EL-170	94V-0	E81340		
		Y	Product	SHINKO SEISAKUSHO LTD.	707V	94V-0	E46669		
			Material	MATSUSHITA ELECTRIC WORKS,LTD.	R-1705	94V-0	E81336		
		X	Product	TANAKA KIKINZOKU KOGYO CO LTD.	TKK-5	94V-0	E118673		
			Material	HITACHI CHEMICAL CO.,LTD.	MCL-E-67	94V-0	E80148		
	Connector	I/F.-PCB	DF14-30P	Product	HIROSE ELECTRIC CO.,LTD.	DF14A-30P-1.25H	-	-	
				Material	TORAY INDUSTRIES INC.	A604	94V-0	E41797	
			FH12-15P	Body	Product	HIROSE ELECTRIC CO.,LTD.	FH12-15S-0.5SH	-	-
				Material	MITSUI CHEMICALS INC.	CH230N	94V-0	E52579	
		Lid	Product	HIROSE ELECTRIC CO.,LTD.	FH12-15S-0.5SH	-	-		
			Material	DAINIPPON INC & CHEMICALS	FZ-1140-D5	94V-0	E53829		
		X-PCB	WR-L60P	Product	JAPAN AVIATION ELECTRONICS INDUSTRY,LTD.	WR-L60P-VF-A1	-	-	
				Material	POLYPLASTICD CO.,LTD.	1140A	94V-0	E109088	
		FPC	WR-L60S	Product	JAPAN AVIATION ELECTRONICS INDUSTRY,LTD.	WR-L60S-VF-1	-	-	
				Material	POLYPLASTICD CO.,LTD.	1140A	94V-0	E109088	
	FPC		DUPONT-TORAY CO.,LTD.		50H	94V-0	E69892		
	Silicone rubber		FUJI POLYMER INDUSTRIES CO LTD		Sarcon FR	94V-1	E58126		
Spacer	Silicone rubber		FUJI POLYMER INDUSTRIES CO LTD		Sarcon FR	94V-1	E58126		
	Conductive spacer		ZIPPERTUBING (JAPAN) LTD.		71TS	94V-1	E158850		
Back Light	Plastic frame		Material	TEIJIN CHEMICAL CO.,LTD.	G3110#	94V-2	E50075		
			Material	TEIJIN CHEMICAL CO.,LTD.	G3115#	94V-2	E50075		
	Light guide		ASAHI KASEI CORP		Delagas AD	94HB	E48285		
	Connector		JAPAN SOLDERLESS TERMINAL MFG CO LTD.		BHR-03VS-1	94V-0	E60389		
	Shrinkable tube		SUMITOMO ELECTRIC FINE POLYMER INC.		Sumitube F(Z) 1.5mm diameter	VW-1	E48762		
			SUMITOMO ELECTRIC FINE POLYMER INC.		Sumitube F(Z) 4.0mm diameter	VW-1	E48762		
	Rubber gap		DOW CORNING TORAY SILICONE CO LTD.		SH871U	94HB	E55519		
	Lead wire		NISSEI ELECTRIC CO LTD.		UL3570 1.6mm diameter	VW-1	E56198		
	Diffuser sheet		MITSUBISHI ENGINEERING-PLASTICS CORP.		PCM1	FH-3	E41179		
	Optical sheet 1		Material	MINNESOTA MINING & MFG CO.	Dual Brightness Enhancement Film	94VTM-2	E71569		
	Optical sheet 2		Material	SUMITOMO DOW LTD.	PCX-3381	94V-2	E123529		
	Tape		NITTO DENKO CORP.		No.156-A	510FR	E34833		
	Insulating sheet		TORAY INDUSTRIES INC.		Lumirror S type	94VTM-2	E86511		

APPROVAL SIGNATURE

## SPECIFICATION

FOR

TOSHIBA TFT-LCD MODULE

**LTM12C275C**

SPECIFICATION No. : \_\_\_\_\_  
NL-LTM12C275C-11

DATE OF ISSUE : 2001-09-13

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T.Nakagawa  
Senior Manager  
Liquid Crystal Display  
Quality Assurance Dept.  
Liquid Crystal Display Div.

<Engineering Department to contact as per SPECIFICATION>  
Liquid Crystal Display Device Marketing & Engineering Dept.  
Liquid Crystal Display Div.  
TOSHIBA Corporation

8, Shinsugita-cho, Isogo-ku, Yokohama 235-8522, JAPAN

**Revision History**

Date	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'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 handling LCD module.  
DO NOT TOUCH the parts inside LCD module and the fluorescent 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 does not specify.  
Otherwise, Toshiba 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 does not warrant the modules, 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.
- (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.

- (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)
$V_{DD}$	<u>4.0</u> A	<u>0.63</u> A	<u>0.63</u> A

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

## For Designing the System

- (1) LCD module should be assembled to the system by using all mounting holes specified in this specification and with the specified screws.
- (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, 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 the FL.
- (4) Keep one FL voltage signal( $V_{FLH1}$ ) phase always exactly same as another FL voltage signal( $V_{FLH2}$ ) phase.  
If does not keep, it may cause smoke or burn by high voltage.
- (5) Make sure to connect correctly high-voltage wire and low-voltage wire between FL tube and inverter unit.
- (6) 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).
- (7) 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.  
Ultra-violet ray cut filter is recommended to apply onto LCD module for outdoor operation. Strong ultra-violet ray may cause damage the panel.
- (8) 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.

## 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 handling LCD modules 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 0.5-1Mohms in order to prevent spark of ESD.
- (2) When remove protection film from LCD panel, peer 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 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.
- \* (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 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.

- (11) Be careful not to pull the FL cables of the backlight in order to avoid mechanical damage in FL lamp and soldering area. 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. This may cause damage of module circuit.  
The signal should be applied after power is turned on. And the signal should be removed before power supplies are turned off. (Refer to "For Designing The System"(2).)
- \*(13) When operation time of a CCFL reached MTBF (ambient temperature: 25 °C) given in specifications or a CCFL becomes pink lighting, please exchange FL unit (CCFL) or a LCD module promptly. The exchange timing conditions are a) a luminance becomes half of initial value, b) an electric discharge color becomes white to pink, and c) a CCFL reaches to its MTBF.  
As characteristic of a CCFL, since the temperature of life-end CCFL rises in connection with drain of effective mercury contained in the CCFL, the continuation of usage of CCFL past its life possibly affect a module, and breakage of a CCFL may occur.  
In addition, the life of CCFL becomes shorter than MTBF indicated by the specifications when ambient temperature is lower than 25 °C. (It even reaches to 1/10 to 1/20 in 0 °C.)
- (a) In the case of the product which allows a CCFL exchange  
Before exchanging a CCFL, please turn off the power supply, which are supplied to LCD module, the incoming signal, etc., and the power supply of the inverter for backlight (please fully turn off the power supply rather than turning off with ON/OFF terminal.). CCFL unit shall be exchanged strictly following to the exchange method described in the specifications of CCFL unit, only after a CCFL puts out the light and the temperature of FL unit part falls in a room temperature.
- (b) In the case of the product, which does not allow a CCFL exchange  
Before exchanging a LCD module, please turn off the power supply, which are supplied to LCD module, the incoming signal, etc., and the power supply of the inverter for backlight (please fully turn off the power supply rather than turning off with ON/OFF terminal.).
- \*(14) 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 characteristics as "4.3.2". But this is not irregular phenomena.  
Moreover, CCFL also has the characteristic of color shift by long period operation.

## For Transportation and Storage

- (1) Do not store LCD module in high temperature, especially in high humidity for a long time (approximately more than one month).  
It is recommended to store LCD module where the temperature is in the range of 0 to 35 degrees Celsius and the relative humidity is lower than 70%.
- (2) Store LCD module 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, otherwise it may cause mis-operation or defects. Keep away LCD module from such ambient.
- (4) In case of transportation of storage after opening the original packing. LCD modules are recommended to be repacked into the original packaging with the same method, especially with same kind of desiccant.

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1. Scope

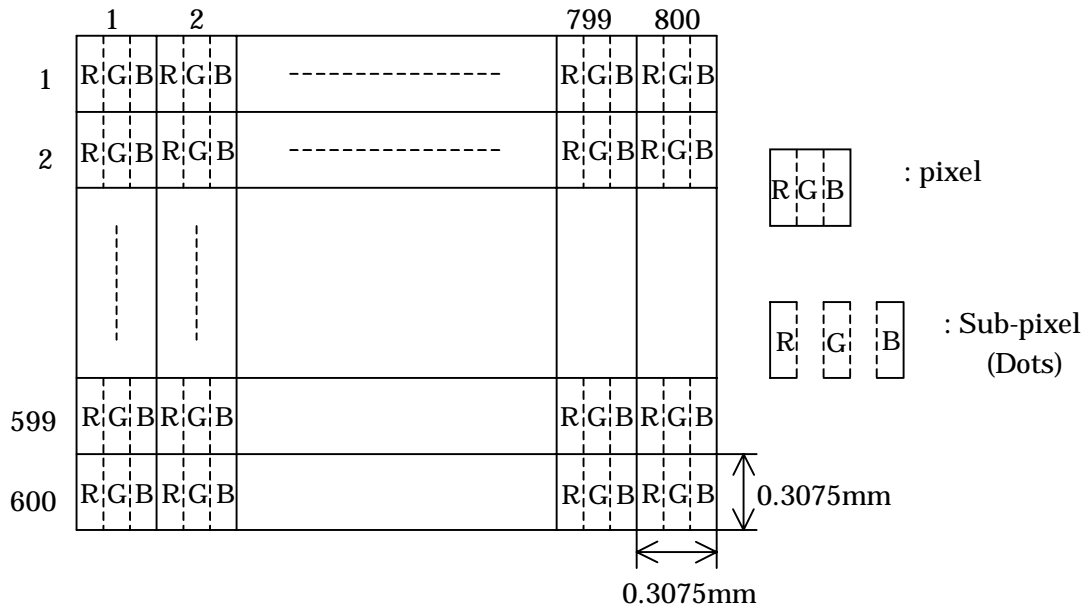
This specification is applicable to Toshiba's 31cm diagonal size TFT-LCD module "LTM12C275C" designed for FA and Monitor equipment.

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	NCLK(clock), ENAB(compound synchronization signal) R5 - R0, (Red display data) G5 - G0, (Green display data) B5 - B0, (Blue display data)
Dimensional Outline	290.0 (W) × 220.0 (H) × 15.0max. (D) (mm)
Active Area	246.0 (W) × 184.5 (H) (mm)
Viewing Area	247.5 (W) × 186.0 (H) (mm)
Number of Pixels	800 (W) × 600 (H) <sup>1)</sup>
Pixel Pitch	0.3075 (W) × 0.3075 (H) (mm) <sup>1)</sup>
Pixel Arrangement	RGB vertical stripes <sup>1)</sup>
Surface Treatment	Anti-glare and hard coat 3H on LCD surface
Backlight	Twin cold-cathode fluorescent lamp for sidelighting

Note 1)



2.2 Absolute Maximum Ratings <sup>1)</sup>

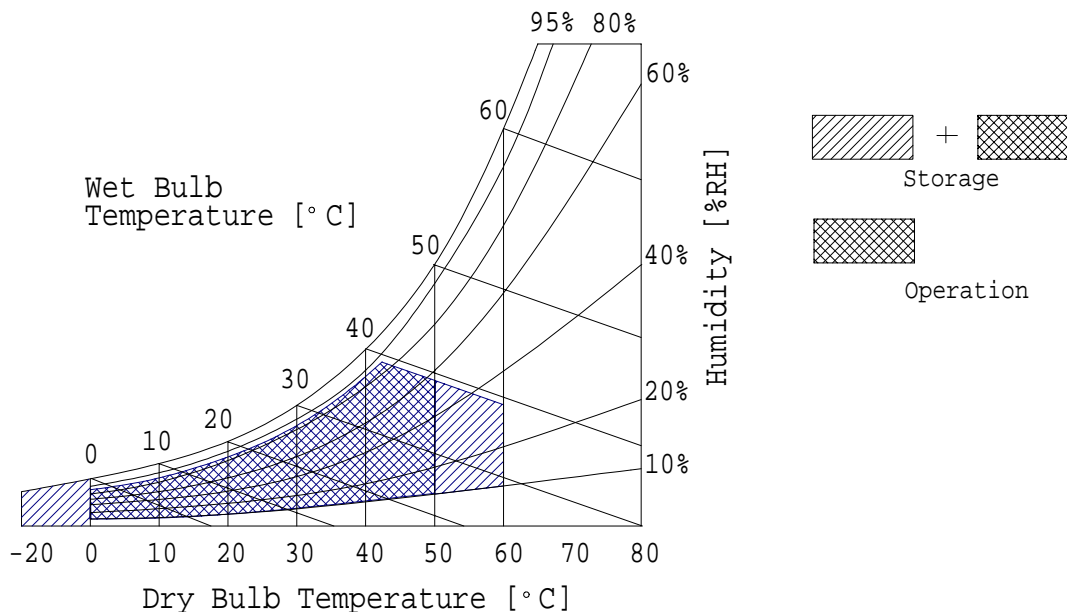
Item	Symbol	Min.	Max.	Unit	Checked Terminal <sup>4)</sup>
Supply Voltage	$V_{DD}$	-0.3	+7.0	V	$V_{DD} - GND$
Input Voltage of Signals	$V_{IN}$	-0.3	$V_{DD}+0.3$	V	R5 - R0, G5 - G0, B5 - B0 NCLK, ENAB
FL Driving Voltage	$V_{FL}$	0	2.0	kV(rms)	
FL Driving Frequency	$f_{FL}$	0	100	kHz	
Operating Ambient Temperature <sup>2)</sup>	$T_{OP}$	0	+50	°C	
Operating Ambient Humidity <sup>2)</sup>	$H_{OP}$	10	90	%(RH)	
Storage Temperature <sup>2)</sup>	$T_{STG}$	-20	+60	°C	
Storage Humidity <sup>2)</sup>	$H_{STG}$	10	90	%(RH)	
Operating Temperature for Panel <sup>3)</sup>	-	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

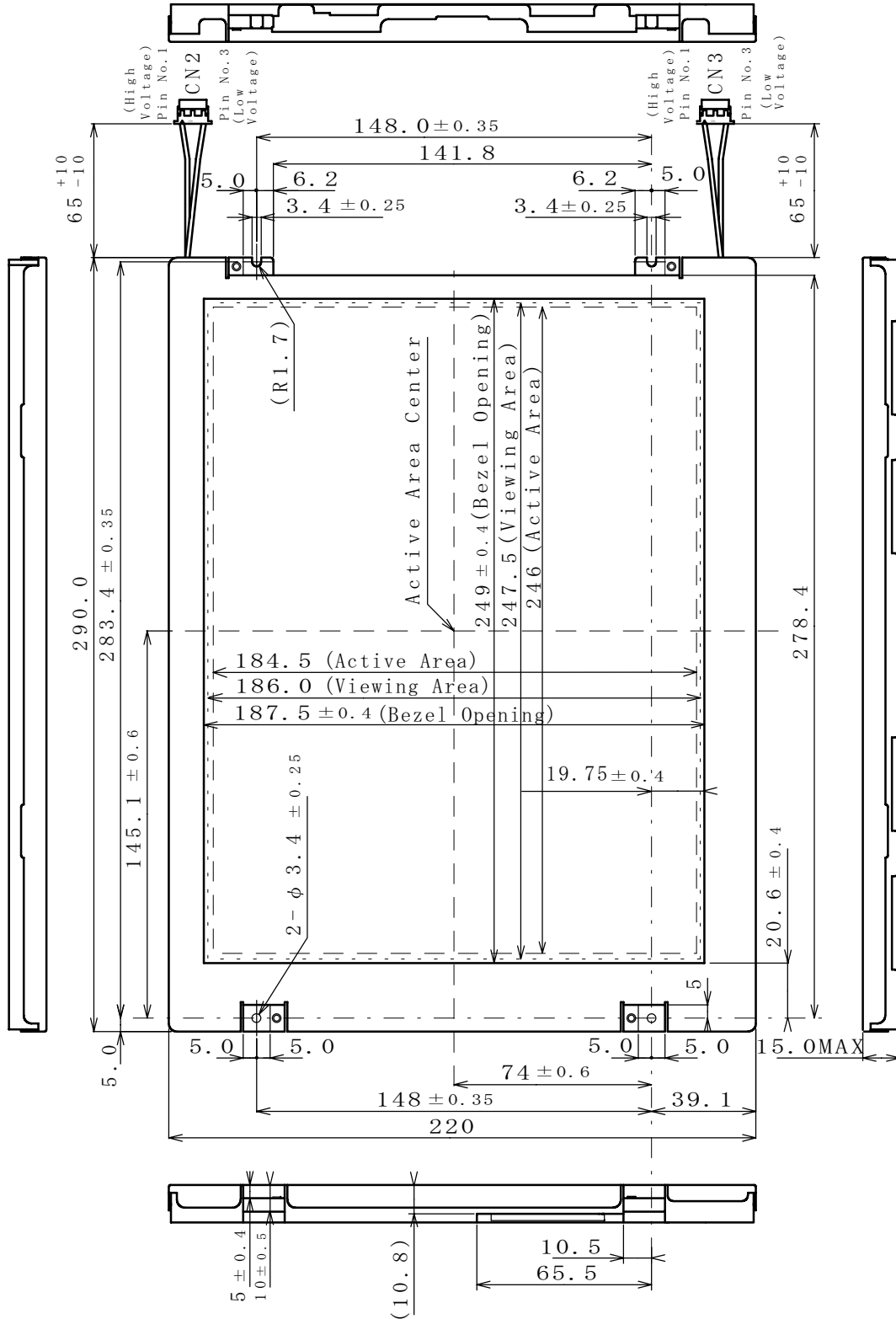
2.3.1 Weight

840 ± 20g

2.3.2 Dimensional Outline  
(front figure)

Unit : mm  
Standard

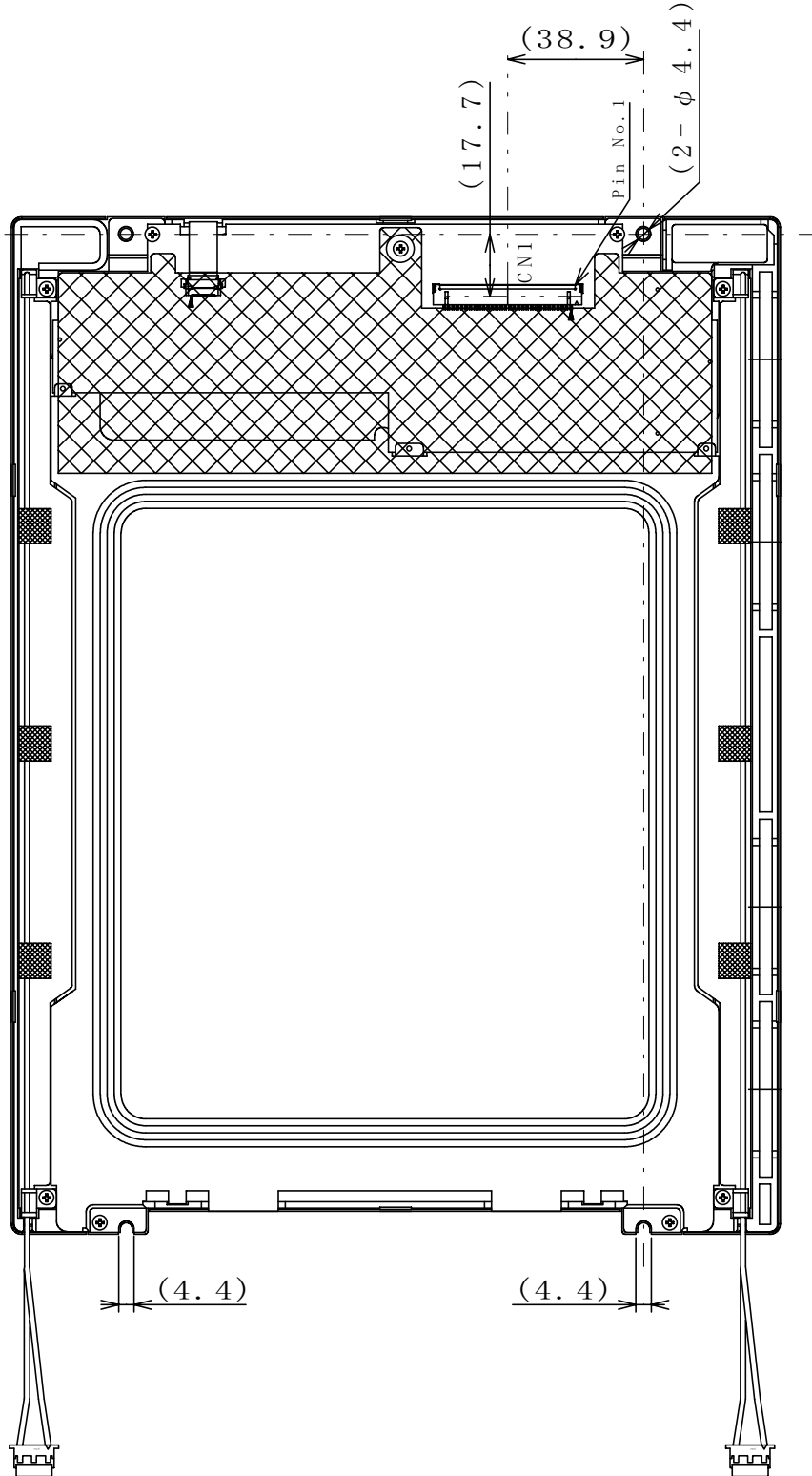
Tolerance : 0.5



(back figure)

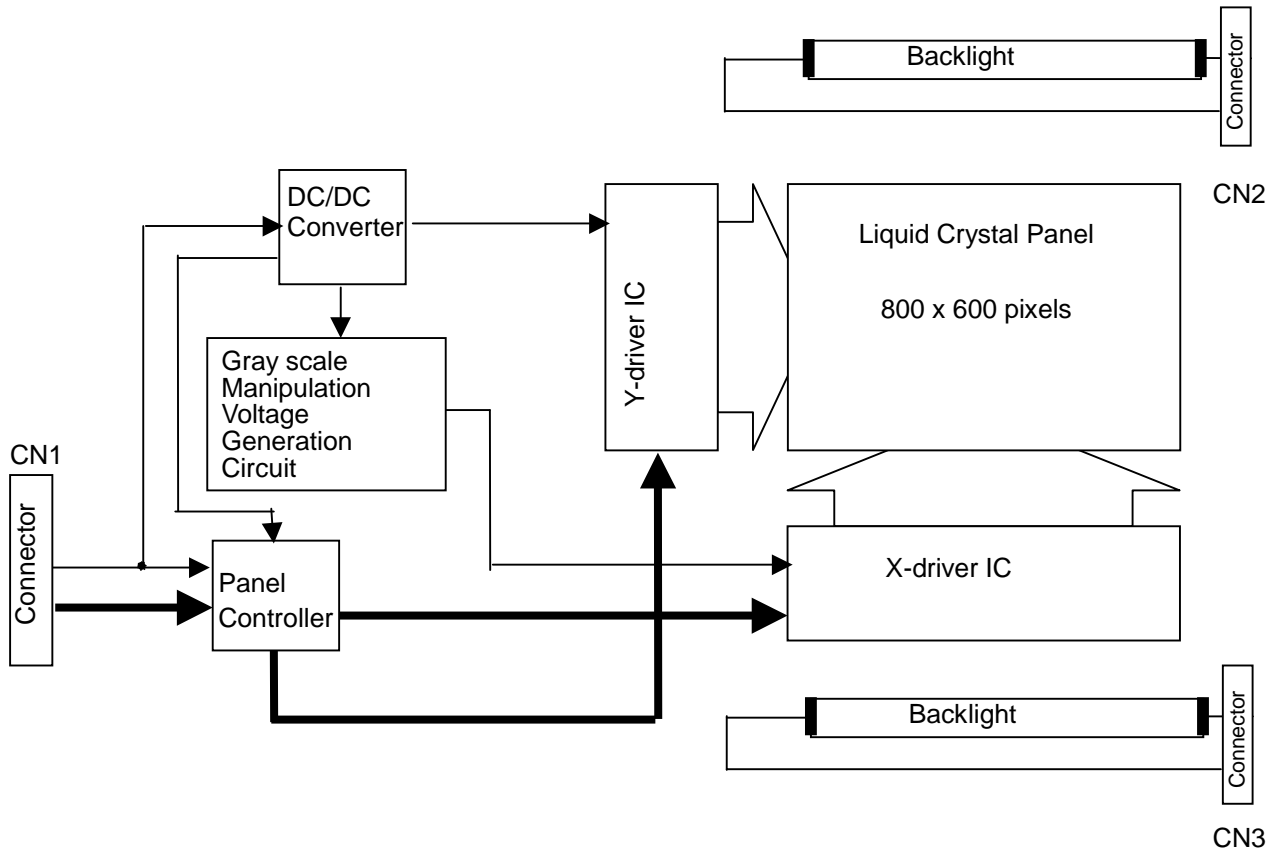
Unit : mm  
Standard

Tolerance : 0.5

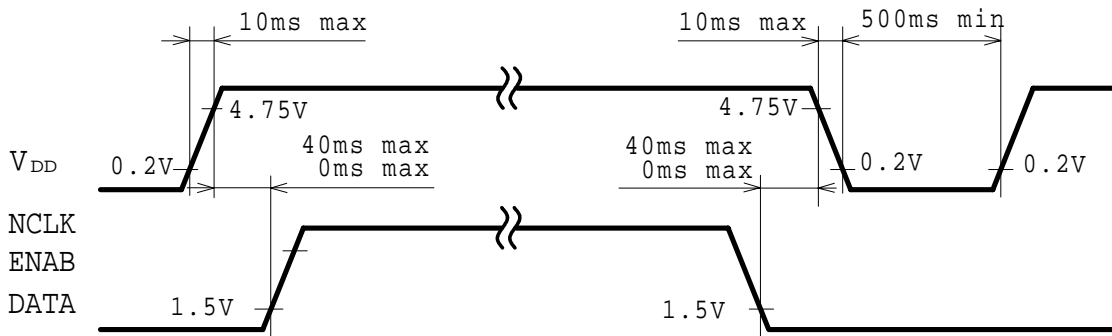


2.4 Electrical Specifications

2.4.1 Circuit Diagram

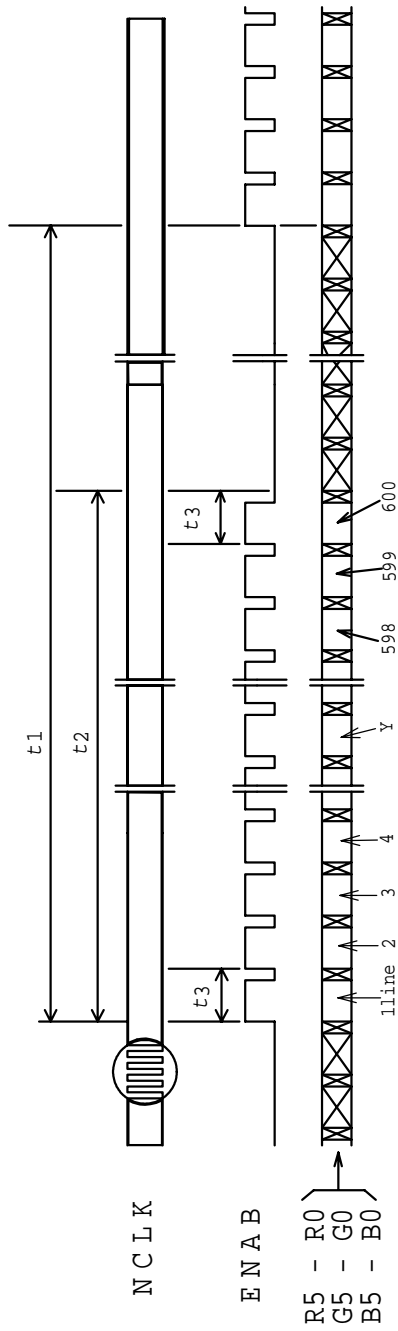


2.4.2 Sequence of Power Supplies and Signals

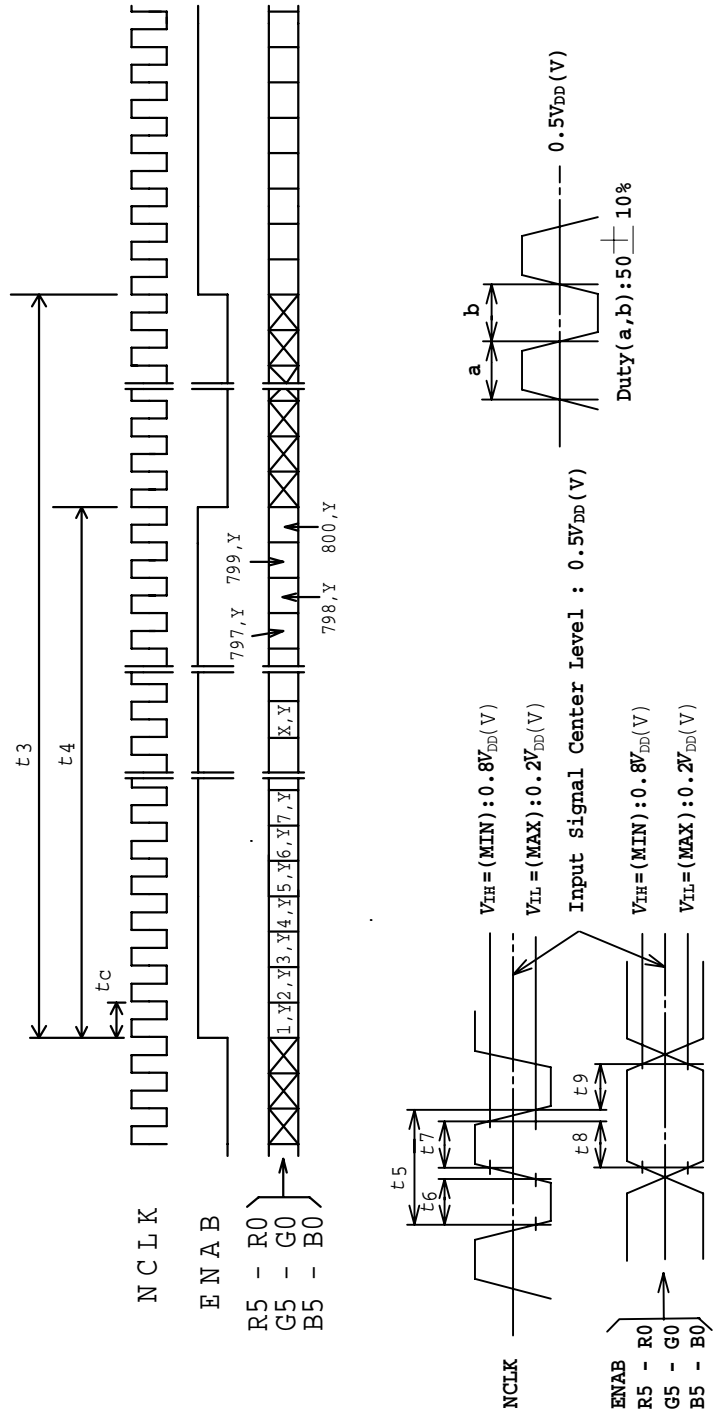


2.4.3 Timing Chart

(1) Vertical Timing



(2) Horizontal Timing



2.4.4 Timing Specifications <sup>1) 2) 3) 4) 5) 6)</sup>

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frame Period	t1	604 × t3	625 × t3	628 × t3	-	
		-	17.78	17.86	ms	
Vertical Display Term	t2	600 × t3	600 × t3	600 × t3	-	
One Line Scanning Time	t3	844 × t5	1024 × t5	1056	-	
		26.4	28.44	-	μs	
Horizontal Display Term	t4	800 × t5	800 × t5	800 × t5	-	
Clock Period	t5	25.0	27.78	-	ns	
Clock "L" Time	t6	5.0	-	-	ns	
Clock "H" Time	t7	8.0	-	-	ns	
Set Up Time	t8	3.0	-	-	ns	
Hold Time	t9	7.0	-	-	ns	

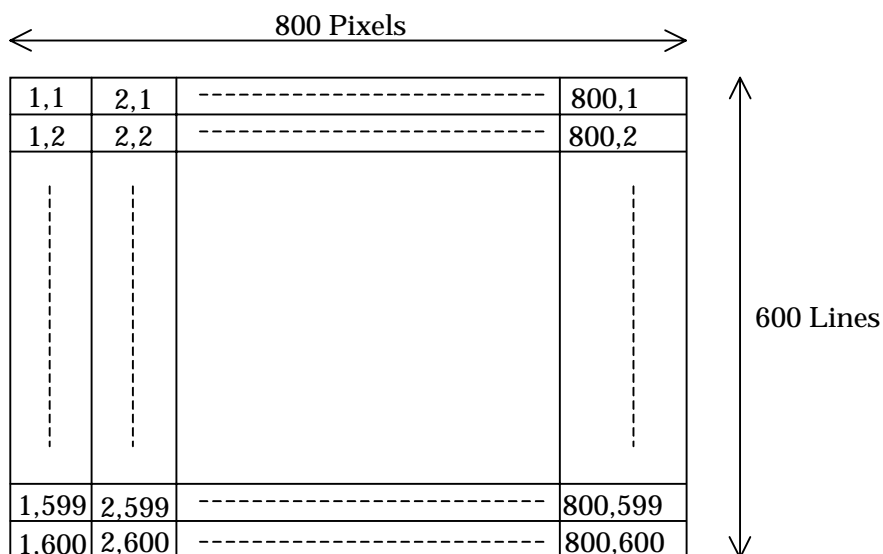
Note 1) Refer to TIMING CHART on page 12.

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) Don't fix NCLK to "H" or "L" level while the V<sub>DD</sub>(+5.0V) is supplied.

If NCLK is fixed to "H" or "L" level for certain period while ENAB is supplied, the panel may be damaged.

Note 4) Display area address is as follows.



Note 5) 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 and recommended operating conditions shown in 3.

Note 6) The following conditions should be met.

- a) NCLK count of each Horizontal Scanning Time should be always the same.
- b) V-Blanking period should be "n" x "Horizontal Scanning Time". (n: integer)
- c) Frame period should be always the same.

## 2.4.5 Interface Connector

CN1 INPUT SIGNAL( DF14A-30P-1.25H / HIROSE ELECTRIC CO.,LTD )

Mating Connector : DF14-30S-1.25C, Contact Pin : DF14-2628SCF, DF14-3032SCF

Terminal No.	Symbol	Function
1	GND	
2	NCLK	SAMPLING CLOCK
3	NC <sup>1)</sup>	
4	NC <sup>1)</sup>	
5	GND	
6	R0 <sup>2)</sup>	RED DISPLAY DATA (LSB)
7	R1 <sup>2)</sup>	RED DISPLAY DATA
8	R2 <sup>2)</sup>	RED DISPLAY DATA
9	R3 <sup>2)</sup>	RED DISPLAY DATA
10	R4 <sup>2)</sup>	RED DISPLAY DATA
11	R5 <sup>2)</sup>	RED DISPLAY DATA (MSB)
12	GND	
13	G0 <sup>2)</sup>	GREEN DISPLAY DATA (LSB)
14	G1 <sup>2)</sup>	GREEN DISPLAY DATA
15	G2 <sup>2)</sup>	GREEN DISPLAY DATA
16	G3 <sup>2)</sup>	GREEN DISPLAY DATA
17	G4 <sup>2)</sup>	GREEN DISPLAY DATA
18	G5 <sup>2)</sup>	GREEN DISPLAY DATA (MSB)
19	GND	
20	B0 <sup>2)</sup>	BLUE DISPLAY DATA (LSB)
21	B1 <sup>2)</sup>	BLUE DISPLAY DATA
22	B2 <sup>2)</sup>	BLUE DISPLAY DATA
23	B3 <sup>2)</sup>	BLUE DISPLAY DATA
24	B4 <sup>2)</sup>	BLUE DISPLAY DATA
25	B5 <sup>2)</sup>	BLUE DISPLAY DATA (MSB)
26	ENAB	COMPOUND SYNCHRONIZATION SIGNAL
27	GND	
28	VDD	+5.0V POWER SUPPLY
29	VDD	+5.0V POWER SUPPLY
30	GND	

CN2 CCFL POWER SOURCE (BHR-03VS-1/JAPAN SOLDERLESS TERMINAL MFG CO.,LTD.)

Mating Connector : SM02(8.0)B-BHS/JAPAN SOLDERLESS TERMINAL MFG CO.,LTD.

Terminal No.	Symbol	Function
1	VL1	CCFL POWER SUPPLY (HIGH VOLTAGE)
2	NC <sup>1)</sup>	
3	GL1	CCFL POWER SUPPLY (LOW VOLTAGE)

CN3 CCFL POWER SOURCE (BHR-03VS-1/JAPAN SOLDERLESS TERMINAL MFG CO.,LTD.)

Mating Connector : SM02(8.0)B-BHS/JAPAN SOLDERLESS TERMINAL MFG CO.,LTD.

Terminal No.	Symbol	Function
1	VL2	CCFL POWER SUPPLY (HIGH VOLTAGE)
2	NC <sup>1)</sup>	
3	GL2	CCFL POWER SUPPLY (LOW VOLTAGE)

Note 1) NC Terminal is open. (Don't use.)

Note 2) 262,144 colors are displayed by the combinations of 18 bits data. (See next page)



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	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
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
	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
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

Note1 L: Low level voltage, H: High level voltage

3. Recommended Operating Conditions <sup>1)</sup>

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply Voltage	$V_{DD}$	4.75	5.00	5.25	V	2)
"H" Level input	$V_{TH}$	0.8 $V_{DD}$	-	$V_{DD}$	V	3)
"L" Level Input	$V_{TL}$	0	-	0.2 $V_{DD}$	V	3)
FL Input Current	$I_{FL}$	3.0	6.0	6.5	mA(rms)	4) 5)
FL Driving Voltage	$V_{FL}$	580	630	680	V(rms)	$I_{FL}=6.0\text{mA(rms)}$ (Reference) 6)
FL Driving Frequency	$f_{FL}$	25	45	65	kHz	6)
FL Starting Voltage	$V_{SFL}$	1400	-	1900	V(rms)	6)

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

Note 2) If FL input current is higher than 6.0mA(rms), then FL lifetime becomes shorter.

Note 3) Checked Pin Terminal:  $V_{DD}$

(GND :  $V_{SS}=0\text{V}$ )

Note 4) Checked Pin Terminal: R5-R0, G5-G0, B5-B0, NCLK, ENAB

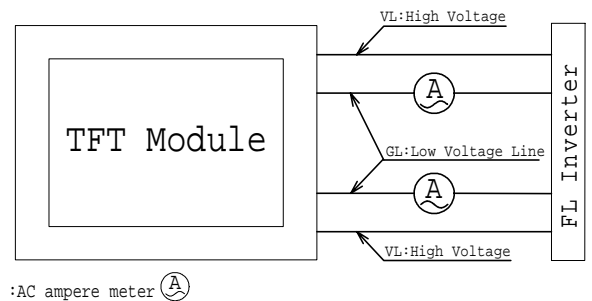
(GND :  $V_{SS}=0\text{V}$ )

Note 5) Checked Pin Terminal: VL1-GL1, VL2-GL2

Note 6) Measuring Method of  $I_{FL}$

Note 7) 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.



4. Electrical Characteristics

4.1 Test Conditions

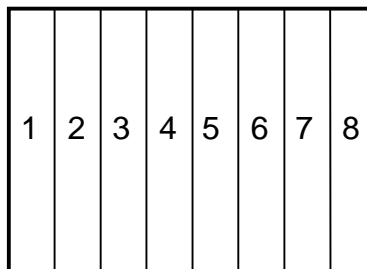
- Ambient Temperature :  $T_a$  25±5°C
- Ambient Humidity :  $H_a$  65±20%RH
- Supply Voltage :  $V_{DD}$  5.0V
- Input Signal : Refer typical value in "2.4.4 Timing Specifications".
- FL Input Current :  $I_{FL}$  6.0mArms
- FL Driving Frequency :  $f_{FL}$  45kHz
- FL Inverter : VNR15C151-INV

4.2 Specifications

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Current Consumption	$I_{DD}$	-	170	270	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



5. Optical Characteristics

5.1 Test Conditions

It is same as 4.1

The measuring method is shown in 11.

5.2 Optical Specifications

Item	Symbol	Conditions	Specifications			Unit	Remark	
			Min.	Typ	Max.			
Viewing Angle	$\theta$	CR $\geq$ 10	$\phi = 180^\circ$	10	-	-	$^\circ$	
			$\phi = 0^\circ$	20	-	-	$^\circ$	
			$\phi = 90^\circ$	30	-	-	$^\circ$	
			$\phi = -90^\circ$	30	-	-	$^\circ$	
Contrast Ratio	CR	$\theta=0^\circ, \phi=0^\circ$	100		-	-		
Response Time	$t_{ON}$	$\theta=0^\circ, \phi=0^\circ$	-		50	ms		
	$t_{OFF}$		-		50	ms		
Luminance	L	$\theta=0^\circ, \phi=0^\circ$ Gray Scale Level=L63 (White)	200	250	-	cd/m <sup>2</sup>	I <sub>FL</sub> =6.0mA (rms)	
Luminance Uniformity	TUNF	$\theta=0^\circ, \phi=0^\circ$ Gray Scale Level=L63 (White)	55	-	-	%		
Chromaticity	Red	$x_R$	Gray Scale Level:L63 $\theta=0^\circ, \phi=0^\circ$	0.52	0.59	0.66	-	
		$y_R$		0.27	0.34	0.41	-	
	Green	$x_G$	Ditto	0.25	0.32	0.39	-	
		$y_G$		0.47	0.54	0.61	-	
	Blue	$x_B$	Ditto	0.08	0.15	0.22	-	
		$y_B$		0.08	0.15	0.22	-	
	White	$x_W$	Ditto	0.26	0.33	0.40	-	
		$y_W$		0.28	0.35	0.42	-	

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 : AQL 0.65 %

Total of Minor Defects : AQL 1.5 %

Sampling Method: ANSI / ASQC Z1.4 (Level II)

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 30cm by the eyes of the inspector from the module
- 5) Inspection Angle :  $\theta=0^\circ, \phi=0^\circ$

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, Dimensional between the mounting holes.	Major
Others	Dimensions specified in this specifications	Minor

6.4 Appearance Test

6.4.1 Test Conditions

- 1) Condition : Non-operating, operating  
Same as 6.2

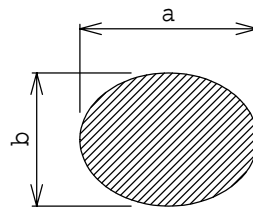
6.4.2 Specifications

Item	Description	Class												
PCB Appearance	Pattern peeling snapping, electrically short	Major												
	Repair portion on PCB is not covered by epoxy resin	Minor												
Soldering	Cold solder joint, lead move when pulled	Major												
Bezel, Frame, Connectors	Distinct stain, rust or scratch	Minor												
Black and White Spots/Lines <sup>1)2)</sup>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Line width</th> <th>Length(mm)</th> <th>Acceptable count</th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.05</math></td> <td rowspan="4" style="text-align: center;"><math>L \leq 3</math></td> <td>neglect</td> </tr> <tr> <td><math>0.05 &lt; W \leq 0.07</math></td> <td><math>n \leq 8</math></td> </tr> <tr> <td><math>0.07 &lt; W \leq 0.10</math></td> <td><math>n \leq 2</math></td> </tr> <tr> <td><math>0.10 &lt; W</math></td> <td><sup>2)</sup></td> </tr> </tbody> </table>	Line width	Length(mm)	Acceptable count	$W \leq 0.05$	$L \leq 3$	neglect	$0.05 < W \leq 0.07$	$n \leq 8$	$0.07 < W \leq 0.10$	$n \leq 2$	$0.10 < W$	<sup>2)</sup>	Minor
	Line width	Length(mm)	Acceptable count											
	$W \leq 0.05$	$L \leq 3$	neglect											
	$0.05 < W \leq 0.07$		$n \leq 8$											
	$0.07 < W \leq 0.10$		$n \leq 2$											
	$0.10 < W$		<sup>2)</sup>											
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Average diameter(mm)</th> <th>Acceptable count/side</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.2</math></td> <td>neglect</td> </tr> <tr> <td><math>0.2 &lt; D \leq 0.3</math></td> <td><math>n \leq 5</math></td> </tr> <tr> <td><math>0.3 &lt; D \leq 0.5</math></td> <td><math>n \leq 2</math></td> </tr> <tr> <td><math>0.5 &lt; D</math></td> <td>0</td> </tr> </tbody> </table>	Average diameter(mm)	Acceptable count/side	$D \leq 0.2$	neglect	$0.2 < D \leq 0.3$	$n \leq 5$	$0.3 < D \leq 0.5$	$n \leq 2$	$0.5 < D$	0			
	Average diameter(mm)	Acceptable count/side												
	$D \leq 0.2$	neglect												
	$0.2 < D \leq 0.3$	$n \leq 5$												
$0.3 < D \leq 0.5$	$n \leq 2$													
$0.5 < D$	0													

Note 1) Inspection area should be within viewing area.

Note 2) Dusts which are bigger not less than 0.10mm ( $0.1 \leq W$ ) shall be judged by "Average Diameter".

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



6.5 Display Quality

6.5.1 Test Conditions

- 1) Inspection Area : Within viewing area
- 2) Condition : Same as test conditions shown in 4.1 and 6.2
- 3) Test Pattern : White display pattern (gray scale level L63) and black display pattern (gray scale level L0)

6.5.2 Specifications <sup>4)</sup>

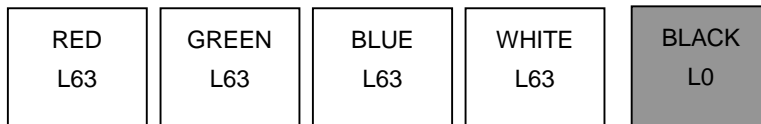
Item	Description / Specifications	Class
Function	No display, Malfunction	Major
Display Quality <sup>1)2)3)</sup>	Missing line	Major
	Missing Sub-Pixels 1) Bright defects : 10pcs. max. 2) Dark defects : 10pcs max. 3) Total sub-pixel defects : 15 pcs max. 4) Total numbers of sub-bright pixel defects within 10mm in diameter : 4 pcs max. 5) Bright defect conjunction (2 sub-pixels) : 2 sets max. 6) Dark defect conjunction (2 sub-pixels) : 2 sets max.	Minor
	Inconspicuous flicker, crosstalk, Newton's ring and other defects : neglect	-
Black and White Spots/line	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 spot which can not be found by using 5%ND-Filter shall not be counted as a defect.

Note 4) Testing is conducted only on RED, GREEN, BLUE, WHITE of gray scale L63,and BLACK of gray scale L0.



## 6.6 Reliability Test

### 6.6.1 Test Conditions

- 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°C, 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 <sup>1)</sup>	50°C 192 h	OK 3p/3p
High Temperature Storage <sup>2)</sup>	60°C 192 h	OK 3p/3p
High Temperature High Humidity operation <sup>1)</sup>	50°C 80% 192 h	OK 3p/3p
Low Temperature Operation <sup>1)</sup>	0°C 192 h	OK 3p/3p
Low Temperature Storage <sup>2)</sup>	-20°C 192 h	OK 3p/3p
Temperature Shock <sup>2)</sup>	-20°C ⇔ 60°C 0.5h 0.5h 50 cycles	OK 3p/3p
Mechanical Vibration <sup>2)</sup>	10 – 200 - 10Hz sweep/cycle, 1.5×9.8m/s <sup>2</sup> constant, X.Y.Z each directions, 0.5h each	OK 3p/3p
Mechanical Shock <sup>2)</sup>	50×9.8m/s <sup>2</sup> , 20ms, ±X, ±Y, ±Z direction, one time each	OK 3p/3p

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 larger than 50% of the minimum value. (Refer to 5.2 Optical Specifications)

6.7 Labels

(1) Product Label

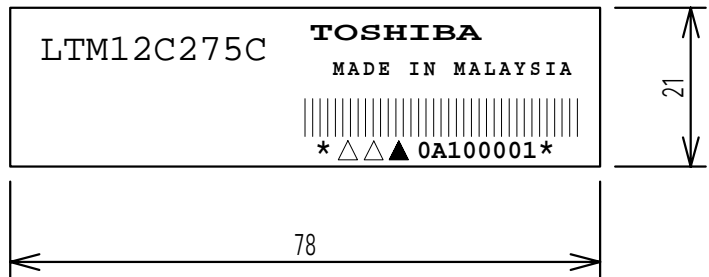
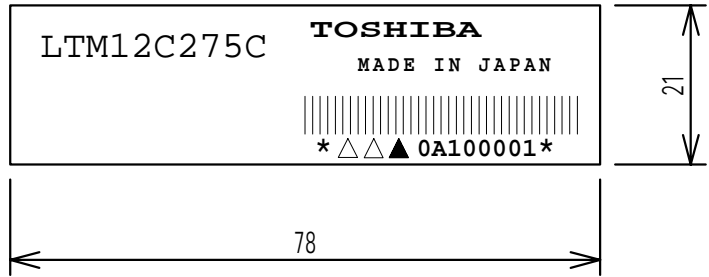
Serial number :  $\triangle\triangle$   $\blacktriangle$   $0A$  100001  
                                   ①   ②   ③   ④

- ① : Module type code
- ② : Manufacturing code  
       C:MADE IN JAPAN  
       M:MADE IN MALAYSIA

- ③ : Lot code  $0$   $A$   
                   (1) (2)  
                   (1):Year code-end of the A.D.  
                   (2):Month code-alphabet  
                           →Jan. : A - Dec. : L

- ④ : Serial code  
       decimal, 6 figures  
       Bar code: CODE-39 High-density

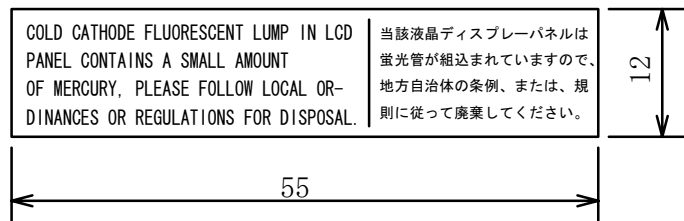
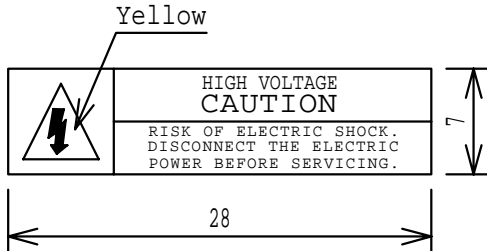
There are two type of label according to country of origin.



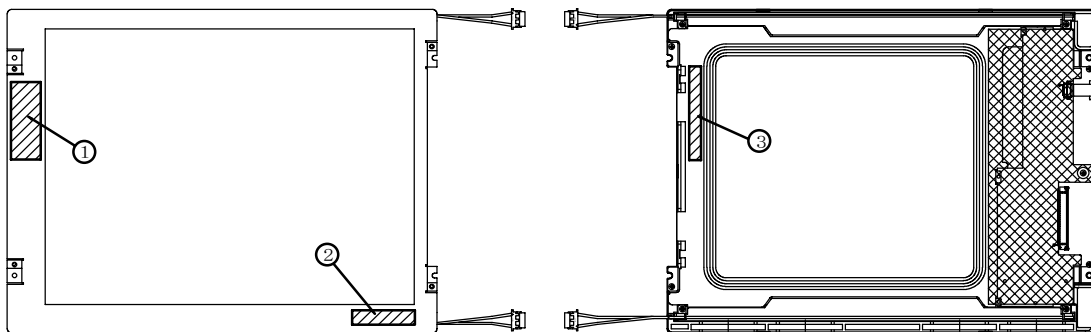
(2) Caution Labels

• High Voltage

• Disposal of CCFL



(3) Label Locations



- ① Product Label
- ②③ Caution Label



## 7. Lifetime

### 7.1 Module (except lamp)

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

## 7.2 Lamp

### 7.2.1 Test Conditions

Ambient temperature : 25±5°C (No wind)

Lamp current : 6.0mAmps

Lighting condition : continuous lighting

### 7.2.2 Specifications

MTBF : 30,000 h

Definitions of failure for judgment shall be as follows.

- 1) LCD luminance becomes half of the minimum value.
- 2) Lamp doesn't light normally.

(Note1) 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 characteristics as "4.3.2". But this is not irregular phenomena .

Moreover, CCFL also has the characteristic of color shift by long period operation.

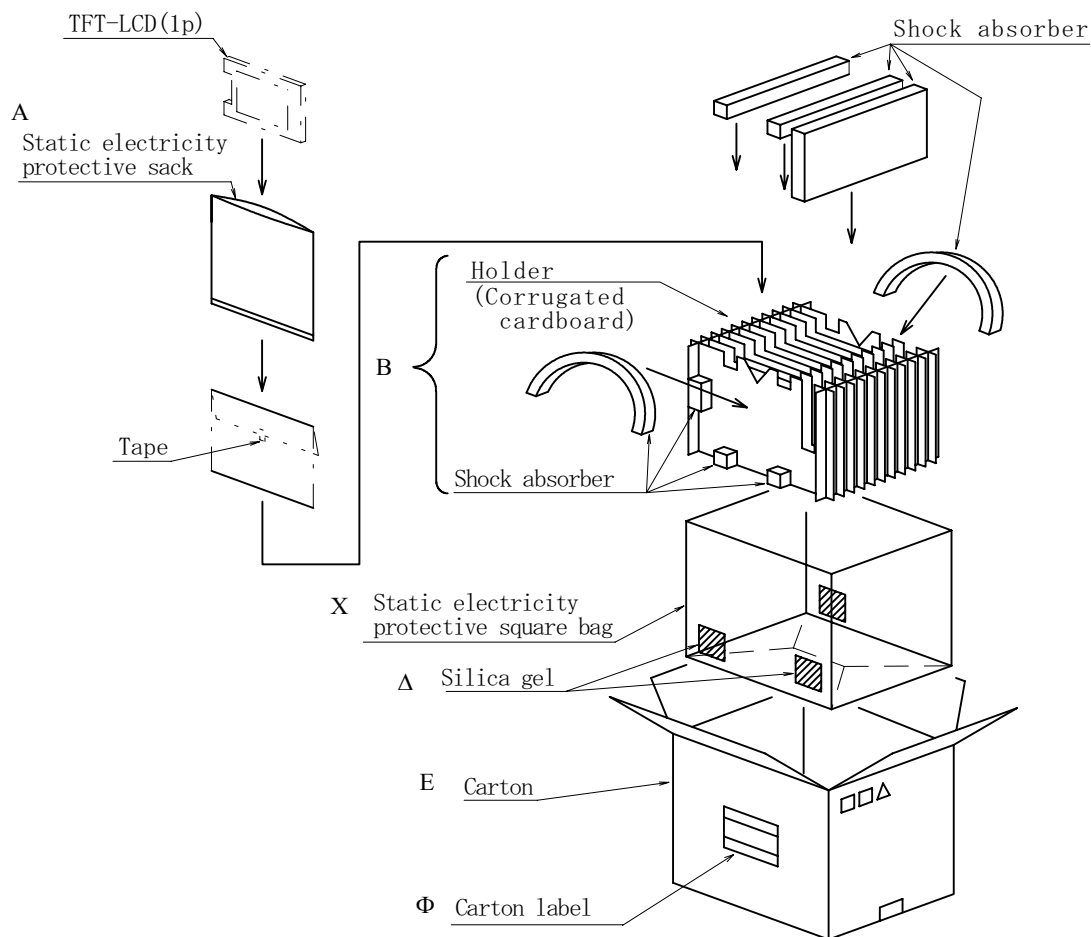
8. Packaging

8.1 Carton (internal package)

(1) Packaging Form

Corrugated cardboard box and polyethylene foam as shock absorber

(2) Packaging Method <sup>1) 2)</sup>

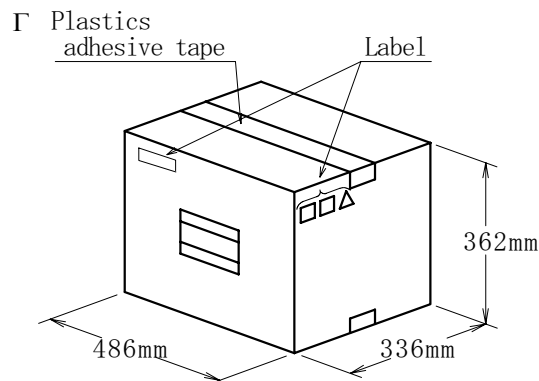


Note 1) : Total weight : (Approx.) 11kg

Note 2) : Acceptable number of piling : 10 sets

(3) Packaging Material

Number	Quantity	Description
①	10	Static electricity Protective sack
②	1 set	Holder(inner box) include shock absorber
③	1	Static electric Protective square bag
④	3	Silicagel(50g×3)
⑤	1 set	Carton
⑥	1	Carton label
⑦		Plastics adhesive tape



**9. Warranty**

Warranty clause will be decided separately.

**10. Regulation**

The set (which our LCD module is assembled into) to conform the regulations below, take measures in set side. Toshiba 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

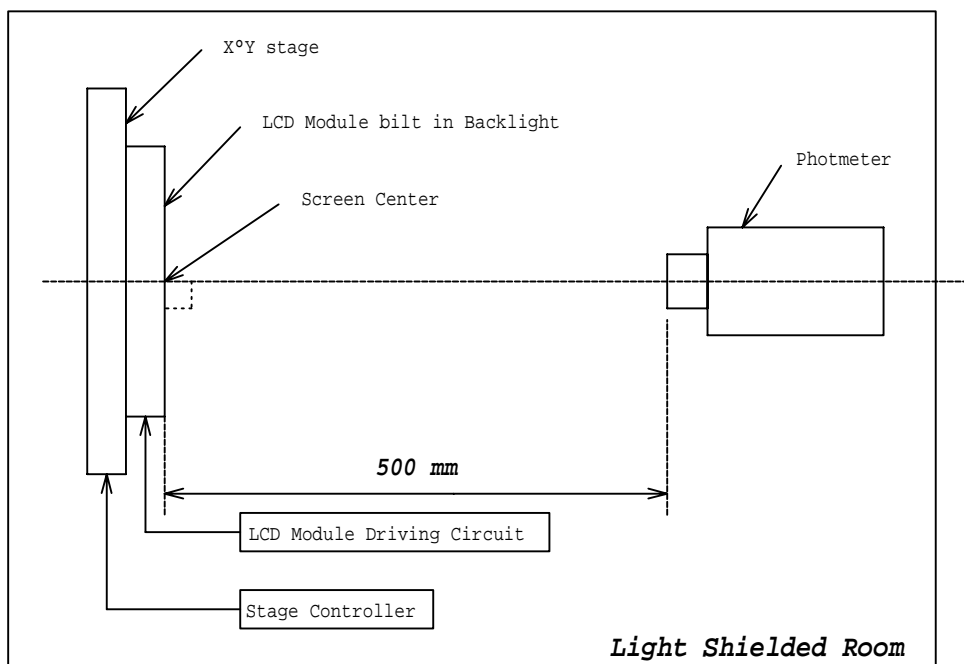
- FCC : PART15 CLASS B
- VCCI : CLASS B
- CISPR : CLASS B

b) Examples of Safety Regulations

- IEC 950
- UL 1950

**11. Measuring Method**

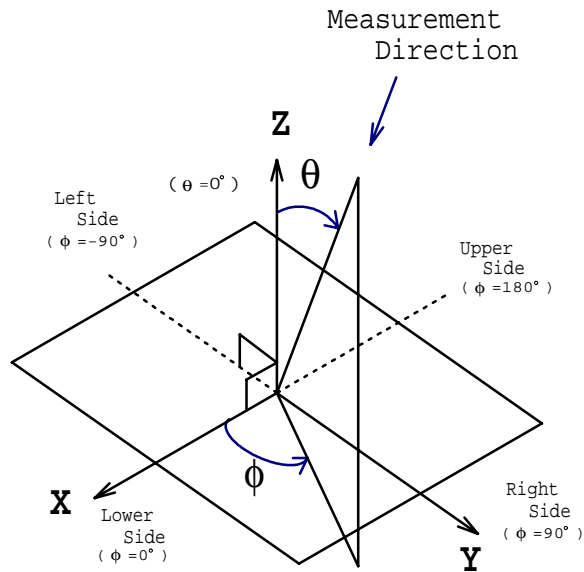
**11.1 Measuring System**



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

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

(3) Definition of  $\phi$  and  $\theta$  :



## 11.2 Measuring Methods

(1) Luminance:

The luminance of the center on a white 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 calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L63 / L0$$

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

L 0 : Luminance on the black raster (gray scale level L0)

(3) Viewing Angle

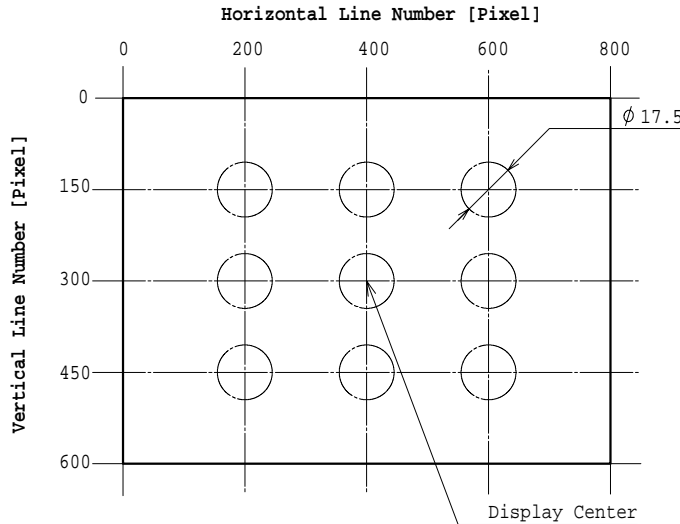
Viewing angle is defined as the angles( $\theta, \phi$ ), in which specified contrast ratio can be obtained.

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

(4) Luminance Uniformity:

The Luminance should be measured at 9 positions on white raster(gray scale level L63).  
 Uniformity can be calculated by the following expression.

$$\text{Luminance Uniformity} = \frac{\text{Minimum Luminance}}{\text{Maximum Luminance}} \times 100\%$$

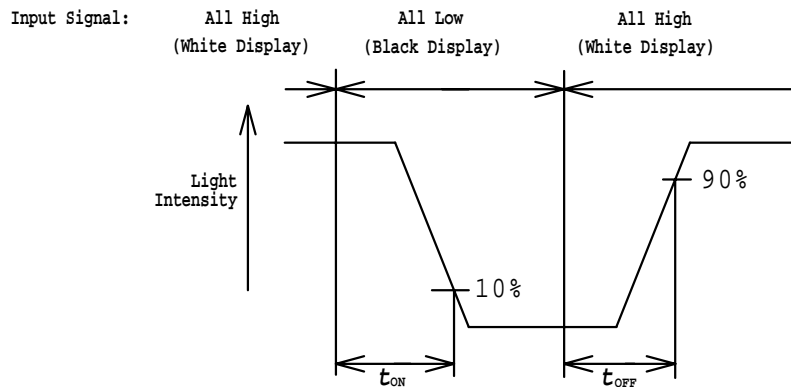


(5) Chromaticity :

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.

(6) Response Time :

The response time ( $t_{ON}$ ,  $t_{OFF}$ ) is measured with a photo detector (photodiode) which measures the light intensity of the pixels.



$t_{ON}$ : Turn on time is the time for a photo detector output waveform to go from maximum value to 10% of its maximum.

$t_{OFF}$ : Turn off time is the time for a photo detector output waveform to go from zero 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)