



# Product Specification

AU OPTRONICS CORPORATION

**B150PG04 V1 (QD15FL02 Rev.01)**

( ) Preliminary Specifications

(V) Final Specifications

Module	<b>15" SXGA+ Color TFT-LCD</b>
Model Name	<b>B150PG04 V1 (QD15FL02 REV01)</b>

Customer	Date	Approved by	Date
_____	_____	_____	_____
Checked & Approved by		Prepared by	
_____	_____	<u>Beyond Yang</u>	<u>4/18/2007</u>
<b>Note: This Specification is subject to change without notice.</b>		<b>MDBU Marketing Division / AU Optronics corporation</b>	

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## 1. Application

This specification applies to a color TFT-LCD module, QD15FL0201.

## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). This module is based on the standards of SPWG (Standard Panels Working Group).

It is composed of a color TFT-LCD panel, driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a 1400×3×1050 dots panel with 262,144 colors by using LVDS (Low Voltage Differential Signaling) to interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The TFT-LCD panel used for this module has very high aperture ratio. A low-reflection and higher-color-saturation type color filter is also used for this panel. Therefore, high-brightness and high-contrast image, which is suitable for the multimedia use, can be obtained by using this module.

Optimum viewing direction is 6 o'clock.

### [Features]

- 1) High aperture panel; high-brightness or low power consumption.
- 2) Brilliant and high contrast image.
- 3) Small footprint and thin shape.
- 4) Light weight.
- 5) RoHS compliant

## 3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	38 ( 15" ) Diagonal	cm
Active area	304.1 (H)×228.1 (V)	mm
Pixel format	1400 (H)×1050 (V)	Pixel
	(1 pixel = R+G+B dots)	
Pixel pitch	0.2172 (H) × 0.2172 (V)	mm
Pixel configuration	R, G, B vertical stripe	
Display mode	Normally white	
Unit outline dimensions (typ.)*1	317.3(W)×242.1 (H)×5.8(D, 6.0 Max)	mm
Mass	Max: 570 (TBD)	g
Surface treatment	Anti-glare and hard-coating 3H Low reflection ( ~5% )	

#### 4. Input Terminals

##### 4-1. TFT-LCD panel driving

CN1 (LVDS interface – NSC/TI standard and +3.3V DC power supply)

Using connector: FI-XB30Sx-HFxx/ FI-X30Sx-HFxx/ equivalent (JAE), locking type

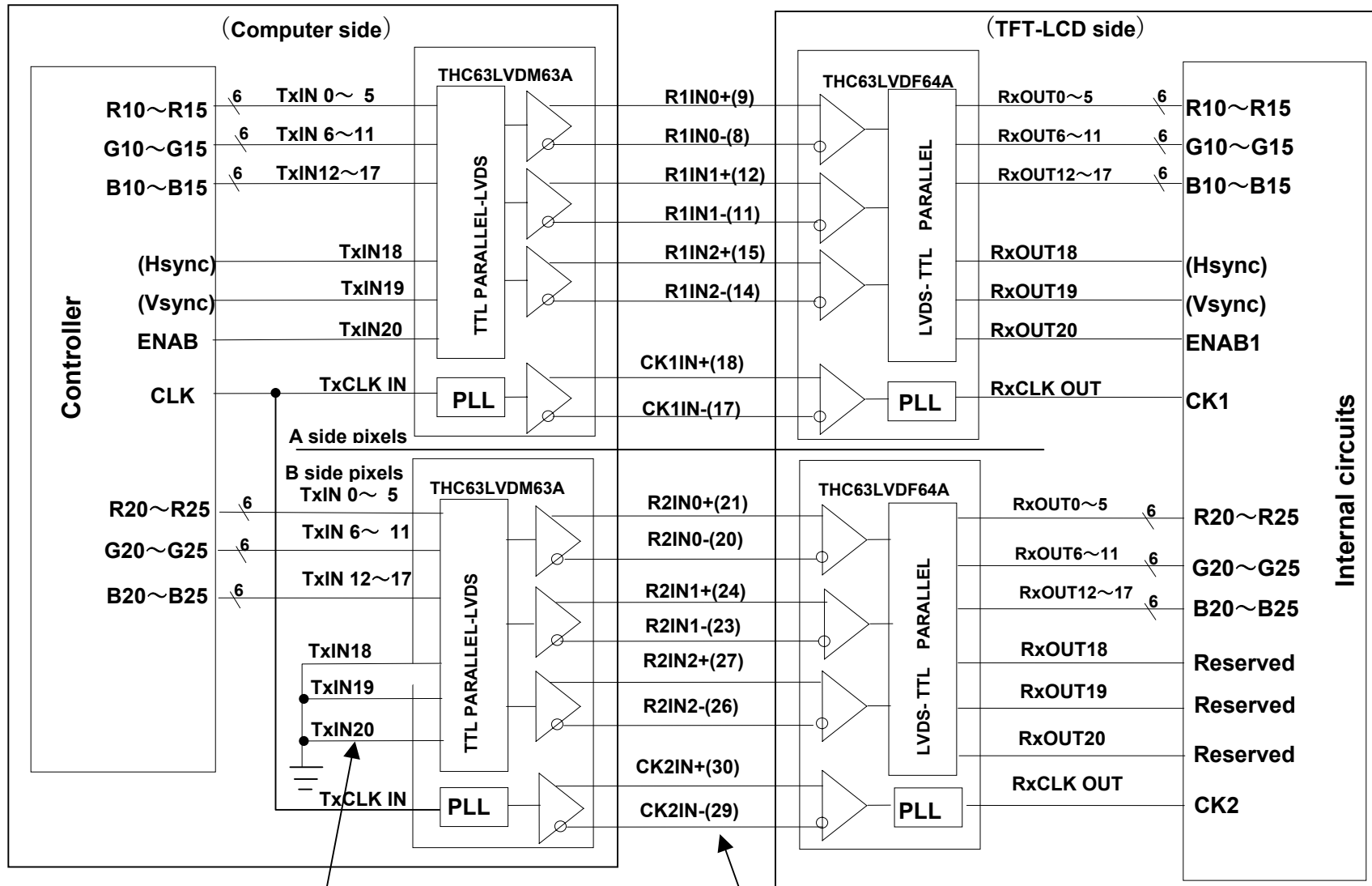
Pin No.	Symbol	Function	Remark
1	GND		
2	VDD	+3.3V power supply	
3	VDD	+3.3V power supply	
4	Vedid	DCC +3.3V power supply	
5	NC	Reserved	
6	CLKedid	DCC Clock	
7	DATAedid	DDC Data	
8	R1IN0-	Receiver signal of A side pixels (-)	LVDS
9	R1IN0+	Receiver signal of A side pixels (+)	LVDS
10	GND		
11	R1IN1-	Receiver signal of A side pixels (-)	LVDS
12	R1IN1+	Receiver signal of A side pixels (+)	LVDS
13	GND		
14	R1IN2-	Receiver signal of A side pixels (-)	LVDS
15	R1IN2+	Receiver signal of A side pixels (+)	LVDS
16	GND		
17	CK1IN-	Clock signal of A side pixels (-)	LVDS
18	CK1IN+	Clock signal of A side pixels (+)	LVDS
19	GND		
20	R2IN0-	Receiver signal of B side pixels (-)	LVDS
21	R2IN0+	Receiver signal of B side pixels (+)	LVDS
22	GND		
23	R2IN1-	Receiver signal of B side pixels (-)	LVDS
24	R2IN1+	Receiver signal of B side pixels (+)	LVDS
25	GND		
26	R2IN2-	Receiver signal of B side pixels (-)	LVDS
27	R2IN2+	Receiver signal of B side pixels (+)	LVDS
28	GND		
29	CK2IN-	Clock signal of B side pixels (-)	LVDS
30	CK2IN+	Clock signal of B side pixels (+)	LVDS

[Note 1] Relation between LVDS signals and actual data shows below section (4-2).

[Note 2] The shielding case is connected with signal GND.

4-2 Interface block diagram

Using receiver : THC63LVDF64A (THINE), Corresponding Transmitter : THC63LVDM63A(THINE),DS90C363,DS90C383(National semiconductor)



TxIN 18~20 must be fixed "Low".

Symbol of CN1 (Pin No.)

#### 4-3. Backlight driving

**CN2: BHSR-02VS-1(JST)**

**Mating connector: SM02B-BHSS-1-TB (JST) or 87210-0200**

Pin No.	Symbol	Function
1	V <sub>HIGH</sub>	Power supply for lamp (High voltage side)
2	V <sub>LOW</sub>	Power supply for lamp (Low voltage side)

#### 5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage	V <sub>I</sub>	T <sub>a</sub> =25°C	-0.3 ~ VDD+0.3	V	[Note1]
+3.3V supply voltage	VDD	T <sub>a</sub> =25°C	0 ~ +4	V	
Storage temperature	T <sub>stg</sub>	-	-25 ~ +60	°C	[Note2]
Operating temperature	T <sub>opa</sub>	-	0 ~ +50	°C	

[Note1] LVDS signals

[Note2] Humidity: 95%RH Max. at T<sub>a</sub> ≤ 40°C.

Maximum wet-bulb temperature at 39°C or less at T<sub>a</sub> > 40°C.

No condensation.

[Note3] When you apply the LCD module for OA system. Please make sure to keep the temperature of LCD module is less than 60°C.

**6. Electrical Characteristics**
**6-1. TFT -LCD panel driving**
**Ta=25°C**

Parameter		Symbol	Min	Typ.	Max.	Unit	Remark
Vcc	Supply voltage	VDD	+3.0	+3.3	+3.6	V	[Note2]
	Current dissipation	IDD	-	420	600	mA	[Note3]
Permissive input ripple voltage		VRP	-	-	100	mV p-p	VDD=+3.3V
Input voltage range		VI	0	-	2.4	V	LVDS signal
Differential input threshold voltage	High	VTH	-	-	+100	mV	Vcm=+1.2V [Note1]
	Low	VTL	-100	-	-	mV	
Input current (High)		IOH	-	-	±10	μA	VI=2.4V VDD=3.6V
Input current (Low)		IOL	-	-	±10	μA	VI=0V VDD=3.6V
Terminal resistor		RT	-	100	-	Ω	Differential input

[Note1] Vcm: Common mode voltage of LVDS driver.

[Note2]

On-off conditions for supply voltage

$$1 < t_1 \leq 10 \text{ ms}$$

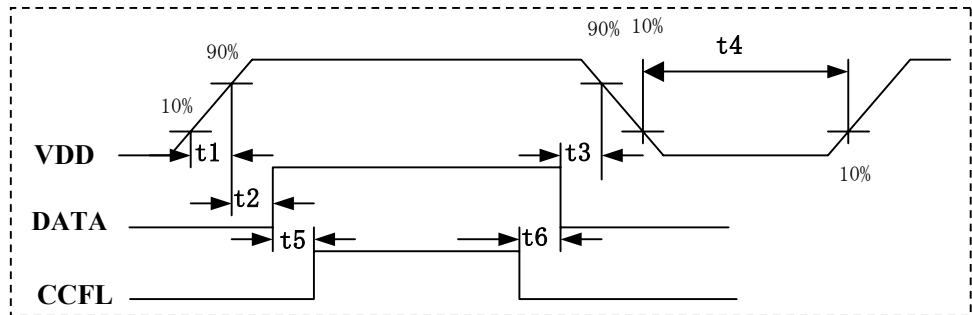
$$0 < t_2 \leq 50 \text{ ms}$$

$$0 < t_3 \leq 50 \text{ ms}$$

$$400 \text{ ms} \leq t_4$$

$$200 \text{ ms} \leq t_5$$

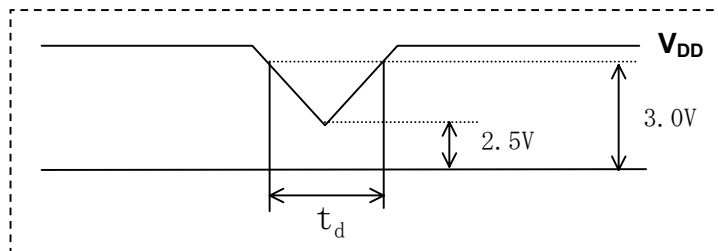
$$200 \text{ ms} \leq t_6$$



V<sub>DD</sub> -dip conditions

1)  $2.5 \text{ V} \leq V_{DD} < 3.0 \text{ V}$   
 $t_d \leq 10 \text{ ms}$

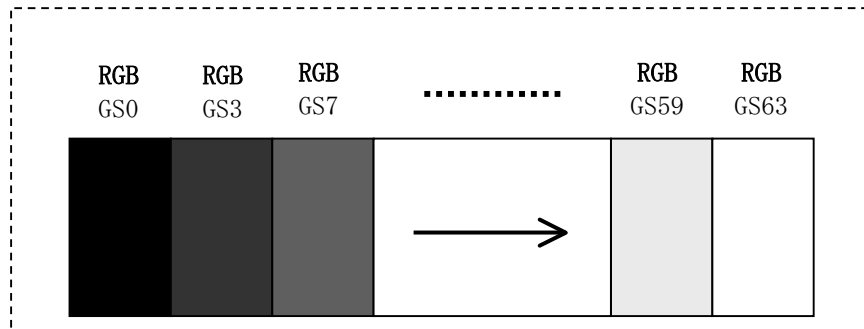
2)  $V_{DD} < 2.5 \text{ V}$



V<sub>DD</sub> -dip conditions should also follow the On-off conditions for supply voltage

[Note3] Typical current situation : 16-gray-bar pattern.

VDD=+3.3V





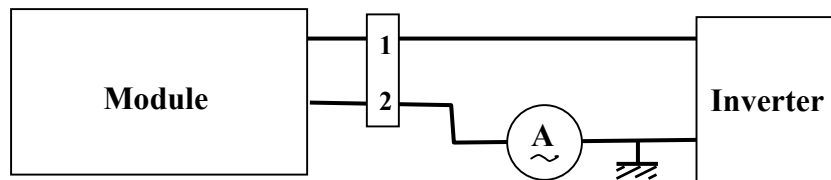
## 6-2. Backlight driving

The backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current range	$I_L$	3.0	6.0	6.5	mArms	<b>【Note1】</b>
Lamp voltage	$V_L$	612	680	748	Vrms	
Lamp power consumption	$P_L$	—	4.08	—	W	<b>【Note2】</b>
Lamp frequency	$F_L$	50	55	60	kHz	<b>【Note3】</b>
Kick-off voltage	$V_s$	—	—	1350	Vrms	$T_a=25^\circ\text{C}$
		—	—	1500	Vrms	$T_a=0^\circ\text{C}$
Lamp life time	$L_L$	15000	—	—	hour	<b>【Note5】</b>

**【Note1】** Lamp current is measured with current meter for high frequency as shown below.



**【Note2】** Calculated Value for reference ( $I_L \times V_L$ )

**【Note3】** Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

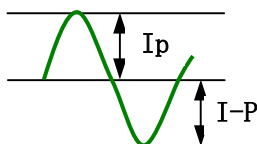
**【Note4】** The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise the lamp may not be turned on.

**【Note5】** Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of  $T_a = 25^\circ\text{C}$  and  $I_L = 6.0$  mArms.

① Brightness becomes 50 % of the original value under standard condition.

② Kick-off voltage at  $T_a = 0^\circ\text{C}$  exceeds maximum value.

**【Note6】** The output of the inverter must have symmetrical waveform of voltage and current. The unsymmetrical rate should be less than 10%. You don't use the inverter which has unsymmetrical voltage, unsymmetrical current and spike wave.



\* Unsymmetrical ratio:  $(|I_p| - |I_{-P}|) / |I_{rms}| \times 100\% \leq 10\%$

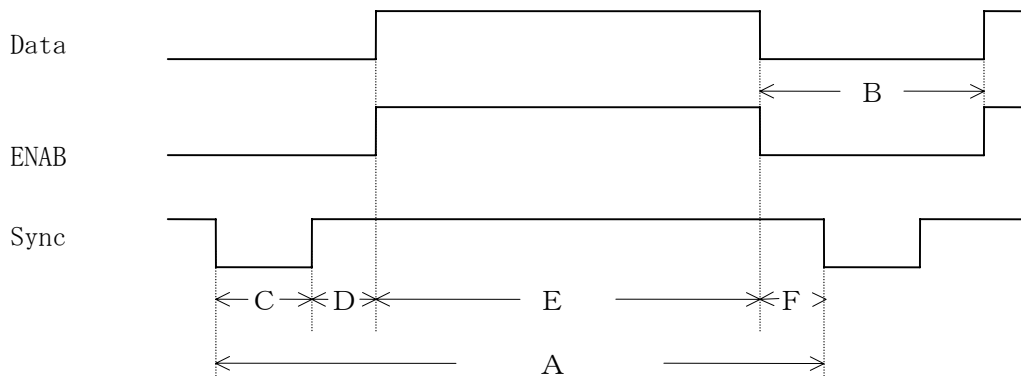
\* Distortion ratio:  $I_p$  (or  $I_{-P}$ ) /  $I_{rms} \leq \sqrt{2} \pm 10\%$

**Note)** The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

## 7. Timing characteristics of input signals

### 7-1. Timing characteristics

(This is specified at digital outputs of LVDS driver.)



(Vertical)

Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Vsync cycle ( $T_{VA}$ )	—	16.667	—	ms	Negative
	1060	1067	1100	line	
Blanking period ( $T_{VB}$ )	10	17	50	line	
Sync pulse width ( $T_{VC}$ )	1	1	4	line	
Back porch ( $T_{VD}$ )	8	14	40	line	
Sync pulse width + Back porch ( $T_{VC}+T_{VD}$ )	9	15	44	line	
Active display area ( $T_{VE}$ )	1050	1050	1050	line	
Front porch ( $T_{VF}$ )	1	2	6	line	

(Horizontal)

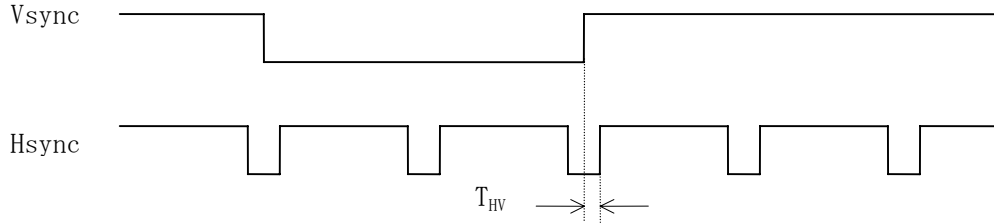
Item (symbol)	Min.	Typ.	Max.	Unit	Remark
Hsync cycle ( $T_{HA}$ )	-	15.6	-	$\mu s$	Negative
	850	864	950	clock	
Blanking period ( $T_{HB}$ )	150	164	250	clock	
Sync pulse width ( $T_{HC}$ )	5	9	10	clock	
Back porch ( $T_{HD}$ )	138	145	225		
Sync pulse width + Back porch ( $T_{HC} + T_{HD}$ )	143	154	235	clock	
Active display area ( $T_{HE}$ )	700	700	700	clock	
Front porch ( $T_{HF}$ )	7	10	15	clock	

(Clock)

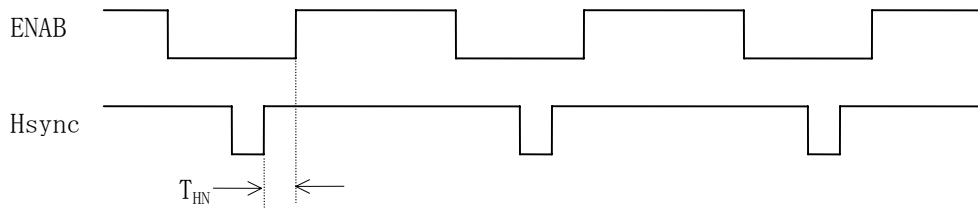
Item	Min.	Typ.	Max.	Unit	Remark
Frequency	50	55	60	MHz	[Note]

Note 1. In case of lower frequency, the deterioration of display quality, flicker etc., may be occurred.

2. Two pixel-data are sampled at a same time.

**(Hsync-Vsync Phase difference)**


Item(symbol)	Min.	Typ.	Max.	Unit	Remark
Hsync-Vsync Phase difference ( $T_{HV}$ )	1	—	$T_{HA} - T_{HC}$	clock	

**(Hsync-ENAB Phase difference)**


Item	Min.	Typ.	Max.	Unit	Remark
( $T_{HN}$ )	10	—	312	clock	

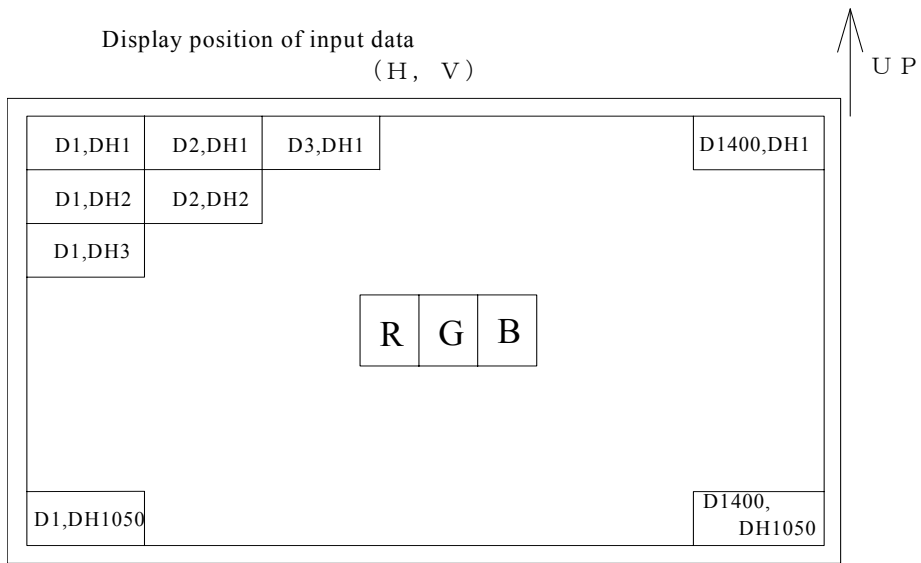
**7-2 Display position**

Item	Standards	Beginning	Ending	Unit	Remark
Horizontal	rising edge of ENAB	0	700	clock	

**Caution**

Image will not be displayed on the right position otherwise.

### 7-3. Input Data Signals and Display Position on the screen



**8. Input Signals, Basic Display Colors and Gray Scale of Each Color**

	Colors & Gray scale	Data signal																	
		Gray scale	R10 R11 R12 R13 R14 R15	G10 G11 G12 G13 G14 G15	B10 B11 B12 B13 B14 B15														
			R20 R21 R22 R23 R24 R25	G20 G21 G22 G23 G24 G25	B20 B21 B22 B23 B24 B25														
Basic Color	Black	-	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	Blue	-	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1														
	Green	-	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0														
	Cyan	-	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 1 1														
	Red	-	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0														
	Magenta	-	1 1 1 1 1 1	0 0 0 0 0 0	1 1 1 1 1 1														
	Yellow	-	1 1 1 1 1 1	1 1 1 1 1 1	0 0 0 0 0 0														
	White	-	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1														
Gray Scale of Red	Black	GS0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	↑	GS1	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	Darker	GS2	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	↑	↓		↓	↓														
	↓	↓		↓	↓														
	Brighter	GS61	1 0 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0														
	↓	GS62	0 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0														
	Red	GS63	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0														
Gray Scale of Green	Black	GS0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	↑	GS1	0 0 0 0 0 0	1 0 0 0 0 0	0 0 0 0 0 0														
	Darker	GS2	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0														
	↑	↓		↓	↓														
	↓	↓		↓	↓														
	Brighter	GS61	0 0 0 0 0 0	1 0 1 1 1 1	0 0 0 0 0 0														
	↓	GS62	0 0 0 0 0 0	0 1 1 1 1 1	0 0 0 0 0 0														
	Green	GS63	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0														
Gray Scale of Blue	Black	GS0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0														
	↑	GS1	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 0 0 0														
	Darker	GS2	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0														
	↑	↓		↓	↓														
	↓	↓		↓	↓														
	Brighter	GS61	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 1 1 1														
	↓	GS62	0 0 0 0 0 0	0 0 0 0 0 0	0 1 1 1 1 1														
	Blue	GS63	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1														

0: Low level voltage, 1: High level voltage Each basic color can be displayed in 64 gray scales from 6 bit data signals.

According to the combination of total 18 bit data signals, the 262, 144-color display can be achieved on the screen.

## 9. EDID data structure

This is the EDID (Extended Display Identification Data) data format to support displays as defined in the VESA Plug & Display.

Byte (decimal)	Byte (hex)	Field Name and Comments	Value (hex)	Value (binary)
<b>Header</b>				
0	0	Header	00	00000000
1	1	Header	FF	11111111
2	2	Header	FF	11111111
3	3	Header	FF	11111111
4	4	Header	FF	11111111
5	5	Header	FF	11111111
6	6	Header	FF	11111111
7	7	Header	00	00000000
<b>Vender/Product ID / EDID Version</b>				
8	8	EISA manufacturer code=QDS	44	01000100
9	9	EISA manufacturer code(Compressed ASCII)	93	10010011
10	0A	Product code (22) LSB	16	00010110
11	0B	Product code MSB	00	00000000
12	0C	ID (32bit) Serial No (zero if not used)	00	00000000
13	0D	ID (32bit) Serial No (zero if not used)	00	00000000
14	0E	ID (32bit) Serial No (zero if not used)	00	00000000
15	0F	ID (32bit) Serial No (zero if not used)	00	00000000
16	10	Week of manufacture	00	00000000
17	11	Year of manufacture – 1990 (ex. 2004-1990=14)	0E	00001110
18	12	EDID structure version # = 1	01	00000001
19	13	EDID revision # = 3	03	00000011
<b>Display Parameter</b>				
20	14	Video I/P definition = Digital I/P	80	10000000
21	15	Max H image size (cm) =30cm	1E	00011110
22	16	Max V image size (cm) =23cm	17	00010111
23	17	Display gamma ( 2.2×100 ) –100	78	01111000
24	18	Features (no DPMS,Active off,RGB,timing BLK1)	0A	00001010
<b>Panel Color Coordinates</b>				
25	19	Red/Green Low bits (RxRy/GxGy)	F1	11110001
26	1A	Blue/White Low bits (BxBY/WxWy)	A0	10100000
27	1B	Red X Rx=0.578	93	10010011
28	1C	Red Y Ry=0.355	5A	01011010
29	1D	Green X Gx=0.305	4E	01001110
30	1E	Green Y Gy=0.560	8F	10001111



31	1F	Blue X Bx=0.155	27	00100111
32	20	Blue Y By=0.135	22	00100010
33	21	White X Wx=0.313	50	01010000
34	22	White Y Wy=0.329	54	01010100
<b>Established Timings</b>				
35	23	Established timings 1 (00h if not used)	00	00000000
36	24	Established timings 2 (1400×1050@60Hz)	00	00000000
<b>Standard Timing ID</b>				
37	25	Manufacturer's timings( 00h if not used)	00	00000000
38	26	Standard timing ID1 (01h if not used)	01	00000001
39	27	Standard timing ID1 (01h if not used)	01	00000001
40	28	Standard timing ID2 (01h if not used)	01	00000001
41	29	Standard timing ID2 (01h if not used)	01	00000001
42	2A	Standard timing ID3 (01h if not used)	01	00000001
43	2B	Standard timing ID3 (01h if not used)	01	00000001
44	2C	Standard timing ID4 (01h if not used)	01	00000001
45	2D	Standard timing ID4 (01h if not used)	01	00000001
46	2E	Standard timing ID5 (01h if not used)	01	00000001
47	2F	Standard timing ID5 (01h if not used)	01	00000001
48	30	Standard timing ID6 (01h if not used)	01	00000001
49	31	Standard timing ID6 (01h if not used)	01	00000001
50	32	Standard timing ID7 (01h if not used)	01	00000001
51	33	Standard timing ID7 (01h if not used)	01	00000001
52	34	Standard timing ID8 (01h if not used)	01	00000001
53	35	Standard timing ID8 (01h if not used)	01	00000001
<b>Timing Descriptor #1</b>				
54	36	Pixel Clock(110M)/10,000 (LSB)	F8	11111000
55	37	Pixel Clock(110M)/10,000 (MSB)	2A	00101010
56	38	Horizontal Active=1400 pixels (lower 8 bits)	78	01111000
57	39	Horizontal Blanking=328 pixels (lower 8bits)	48	01001000
58	3A	Horizontal Active: Horizontal Blanking (upper 4:4 bits)	51	01010001
59	3B	Vertical Active =1050 lines (lower 8bits)	1A	00011010
60	3C	Vertical Blanking=17 lines (lower 8bits)	11	00010001
61	3D	Vertical Active : Vertical Banking (upper 4:4 bits)	40	01000000
62	3E	Horizontal Sync.Offset =20 pixels	14	00010100
63	3F	Horizontal Sync.Width=18 pixels	12	00010010
64	40	Vertical Sync. Offset: lines Sync. Width	21	00100001
65	41	Horizontal/Vertical Sync Offset/Width upper 2 bits	00	00000000
66	42	Horizontal Image Size=304.1mm (lower 8 bits)	30	00110000
67	43	Vertical Image Size=228.1mm (lower 8 bits)	E4	11100100
68	44	Horizontal : Vertical Image Size (upper 4:4 bits)	10	00010000



69	45	Horizontal Border (zero for internal LCD)	00	00000000
70	46	Vertical Border (zero for internal LCD)	00	00000000
71	47	Non-interlaced,Normal,no stereo,Separate sync,H/V pol negatives	18	00011000
<b>Timing Descriptor #2 MANUFACTURER SPECIFIED RANGE TIMING Descriptor</b>				
72	48	Flag	00	00000000
73	49	Flag	00	00000000
74	4A	Flag	00	00000000
75	4B	Data Type Tag : Descriptor Defined by Manufacturer	0F	00001111
76	4C	Flag	00	00000000
77	4D	Value=HSPW min/2 (pixel clks)	05	00000101
78	4E	Value=HSPW max/2 (pixel clks)	0A	00001010
79	4F	Value=Thbp min/2 (pixel clks)	8F	10001111
80	50	Value=Thbp max/2 (pixel clks)	EB	11101011
81	51	Value=VSPW min/2 (line pulses)	01	00000001
82	52	Value=VSPW max/2 (line pulses)	02	00000010
83	53	Value=Tvbp min/2 (line pulses)	05	00000101
84	54	Value=Tvbp max/2 (line pulses)	16	00010110
85	55	Thp min=value*2+HA pixel clks (pixel clks)	96	10010110
86	56	Thp max=value*2+HA pixel clks (pixel clks)	FA	11111010
87	57	Tvp min=value*2+VA lines	05	00000101
88	58	Tvp max=value*2+VA lines	19	00011001
89	59	Module revision	01	00000001
<b>Timing Descriptor #3 : ASCII String : Supplier Name</b>				
90	5A	Flag	00	00000000
91	5B	Flag	00	00000000
92	5C	Flag	00	00000000
93	5D	Data Type Tag : Module serial number	FE	11111110
94	5E	Flag	00	00000000
95	5F	1st character of string=Q	51	01010001
96	60	2nd character of string=U	55	01010101
97	61	3rd character of string=A	41	01000001
98	62	4th character of string=N	4E	01001110
99	63	5th character of string=T	54	01010100
100	64	6th character of string=A	41	01000001
101	65	7th character of string=D	44	01000100
102	66	8th character of string=l	49	01001001
103	67	9th character of string=S	53	01010011
104	68	10th character of string=P	50	01010000
105	69	11th character of string=L	4C	01001100
106	6A	12th character of string=A	41	01000001





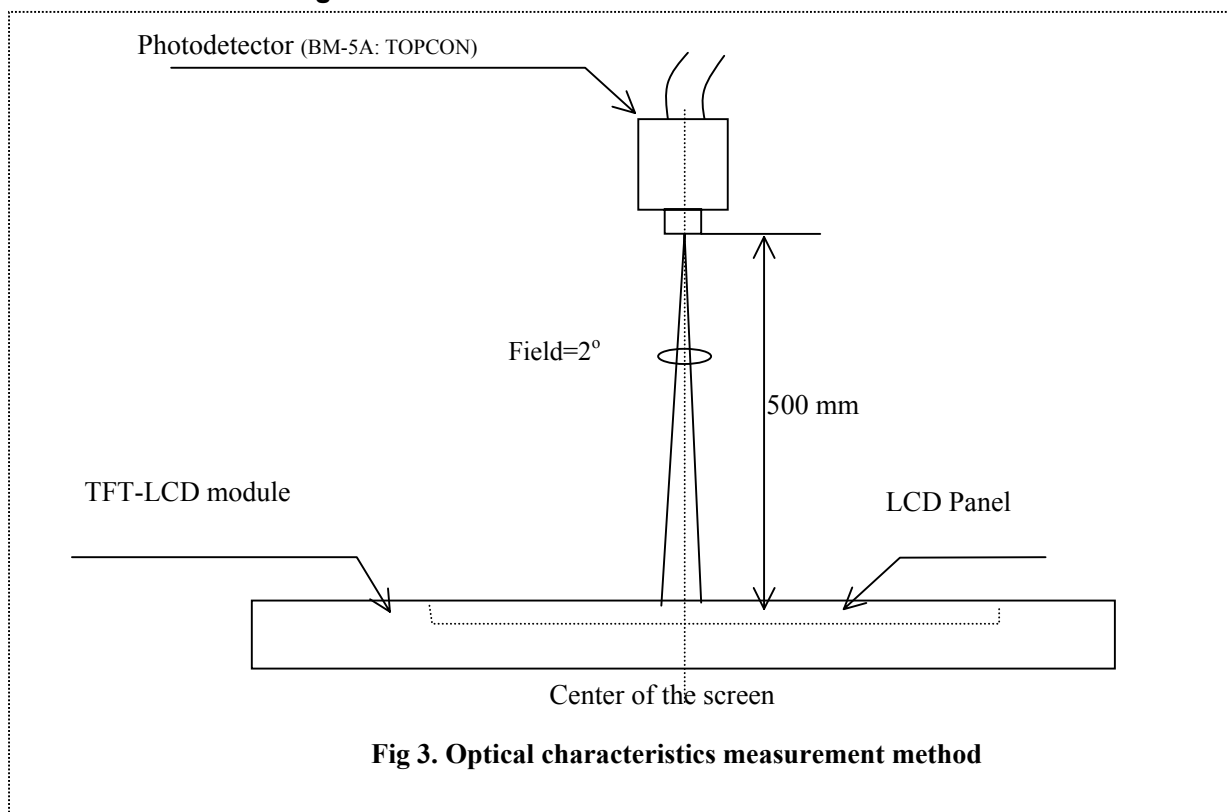
107	6B	13th character of string=Y	59	01011001
<b>Timing Descriptor #4 ASCII String : Supplier P/N</b>				
108	6C	Flag	00	00000000
109	6D	Flag	00	00000000
110	6E	Flag	00	00000000
111	6F	Data Type Tag : Module Name	FE	11111110
112	70	Flag	00	00000000
113	71	Q	51	01010001
114	72	D	44	01000100
115	73	1	31	00110001
116	74	5	35	00110101
117	75	F	46	01000110
118	76	L	4C	01001100
119	77	0	30	00110000
120	78	2	32	00110010
121	79	Product revision (ex :1)	31	00110001
122	7A	Terminate with ASCII code 0Ah	0A	00001010
123	7B	Pad field with ASCII code 20h	20	00100000
124	7C	Pad field with ASCII code 20h	20	00100000
125	7D	Pad field with ASCII code 20h	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	8B	10001011

**10. Optical Characteristics**
**Ta=25°C, VDD=+3.3V**

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	Left,Right	CR>10	50	60	—	Deg.	【Note1,4】
	Vertical	Up		35	45	—	Deg.	
		Down		35	45	—	Deg.	
Contrast ratio		C R n	$\theta = 0^\circ$	350	400	—		【Note2,4】
Response Time	Rise	$\tau r$	$\theta = 0^\circ$	—	8	10	ms	【Note3,4】
	Decay	$\tau d$		—	20	25	ms	
Chromaticity of White		$W_x$ $W_y$		0.293 0.309	0.313 0.329	0.333 0.349		【Note4】
Chromaticity of Red		$R_x$ $R_y$		0.548 0.325	0.578 0.355	0.608 0.385		
Chromaticity of Green		$G_x$ $G_y$		0.275 0.530	0.305 0.560	0.335 0.590		
Chromaticity of Blue		$B_x$ $B_y$		0.125 0.100	0.155 0.130	0.185 0.160		
Luminance of white 【Note4】		$Y_{L2}$	5P Ave.	150	170	—	Cd/m <sup>2</sup>	$I_L = 6.0 \text{ mArms}$
White Uniformity		$\delta_w$	5 Points	—	—	1.4		【Note5】

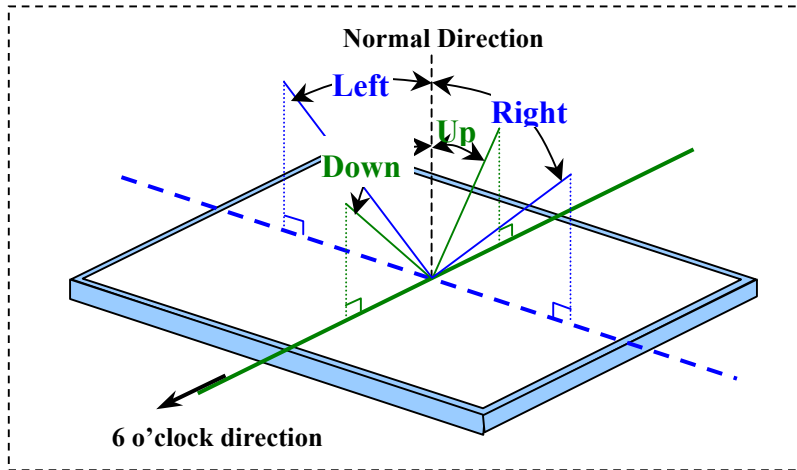
※ The measurement shall be executed 30 minutes after lighting at rating. (typical condition:  $I_L = 6.0 \text{ mArms}$ )

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.2 below.



**Fig 3. Optical characteristics measurement method**

**[Note1] Definitions of viewing angle range:**



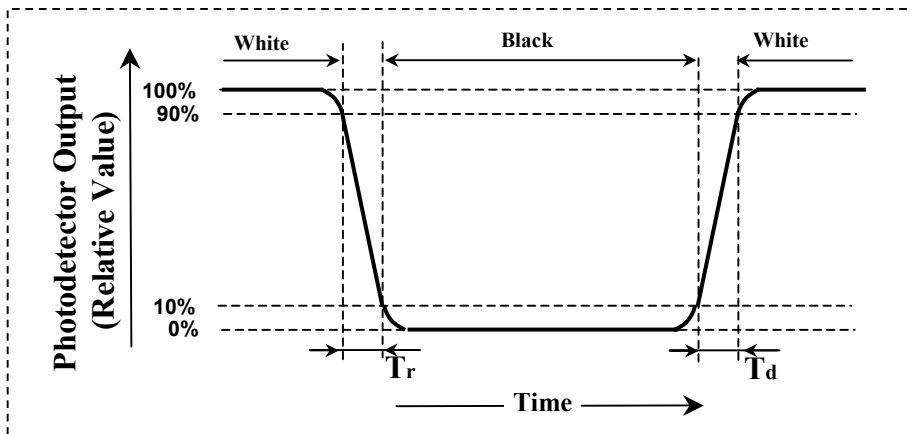
**[Note2] Definition of contrast ratio:**

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

**[Note3] Definition of response time:**

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



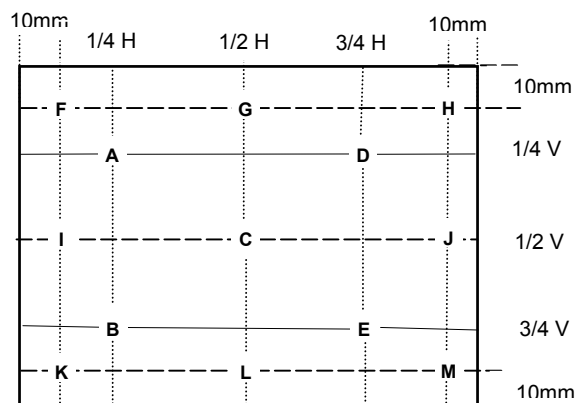
**[Note4] This shall be measured at center of the screen.**

**[Note5] Definition of white uniformity:**

$$\delta_w = \frac{\text{Maximum Luminance of 5/13 points}}{\text{Minimum Luminance of 5/13 points}}$$

\*1) 5 Points are A~E

\*1) 13 Points are A~M



## **11. Display Quality**

**The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.**

## **12. Handling Precautions**

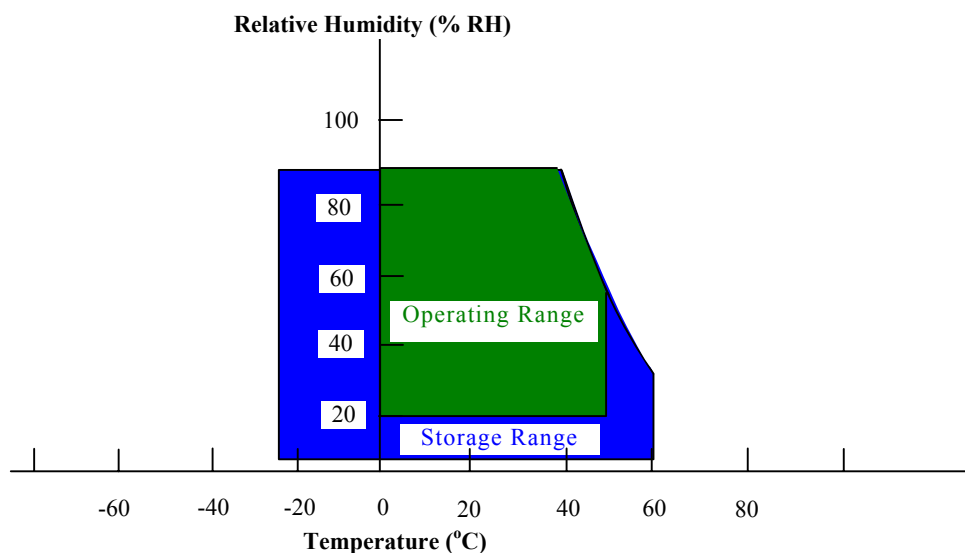
- a) Be sure to turn off the power supply when inserting or disconnecting the cable.**
- b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.**
- c) Since the front polarizer is easily damaged, pay attention not to scratch it.**
- d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.**
- e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.**
- f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.**
- g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.**
- h) Observe all other precautionary requirements in handling components.**
- i) This module has its circuitry PCBs on the rear side and should be handled carefully in order not to be stressed.**
- j) Laminated film is attached to the module surface to prevent it from being scratched. Peel the film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc..**
- k) Cold cathode fluorescent lamp in LCD panel contains a small amount of mercury, please follow local ordinance or regulation for disposal.**

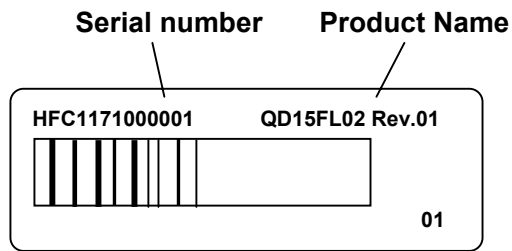
**13. Reliability test items**

No.	Test item	Conditions
1	High temperature storage test	Ta = 65°C 240h
2	Low temperature storage test	Ta = -25°C 240h
3	High temperature & high humidity operation test	Ta = 40°C ; 90 %RH 240h ; (As remark 3) (No condensation)
4	High temperature operation test	Ta = 50°C 240h (The panel temp. must be less than 60°C)
5	Low temperature operation test	Ta = 0°C 240h
6	Vibration test (non- operating)	1.5Grms 30min/each axis random Sweep time: 11 minutes Test period: 3 hourszx (1 hour for each direction of X, Y, Z)
7	Shock test (non- operating)	Max. gravity: 220G Pulse width: 2 ms, sine wave Direction : ±X,±Y,±Z once for each direction.
8	Altitude test (Operating)	700 hPa (3000m) / 48hr
9	Altitude test (Storage)	260 hPa (10000m) / 48hr

**Remark:**

- (1) A failure is defined as the appearance of pixel failed on any color layer or the appearance of horizontal or vertical lines, bars etc.
- (2) Low temperature storage “ Panel must return to operating temperature range prior to activation.”
- (3) Hi temperature / Humidity test  
Max. wet-bulb temperature is less than 39°C ; At glass temperature high than 40 °C.  
Temperature and relative humidity range is shown in the figure below.



**14. Others****1) Lot No. Label:**

- 2) **Adjusting volume has been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.**
- 3) **Disassembling the module can cause permanent damage and should be strictly avoided.**
- 4) **Please be careful since image retention may occur when a fixed pattern is displayed for a long time.**
- 5) **If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.**

15. Outline drawing

