1. Scope

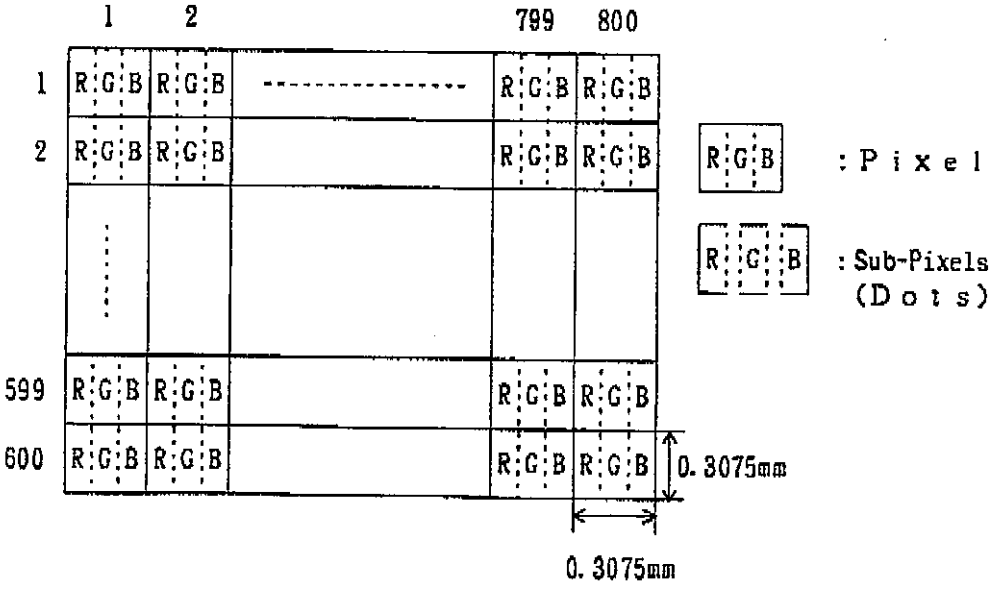
This specification is applicable to a diagonal 31cm size color TFT (Thin Film Transistor)-LCD Module designed for Personal Computer. Toshiba model name : "LTM12C268E" .

2. Product Specifications

2.1 General Specifications

Item	Specifications
Display Mode	TN color(64 gray scales, 262k 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)
Active Area	246.0(W) × 184.5(H) (mm)
Viewing Area	249.0(W) × 187.5(H) (mm)
Number of Pixels	800 (W) × 600 (H)
Pixel Pitch	0.3075(W) × 0.3075(H)(mm)
Pixel Arrangement	RGB vertical stripes
Surface Treatment	Anti-glare and hard coat 3H on LCD surface
Backlight	Single cold-cathode fluorescent lamp for sidelighting
Dimensional Outline	275.0×195.0×7.5max. (mm)

Note 1)



2. 2 Absolute Maximum Ratings[1]

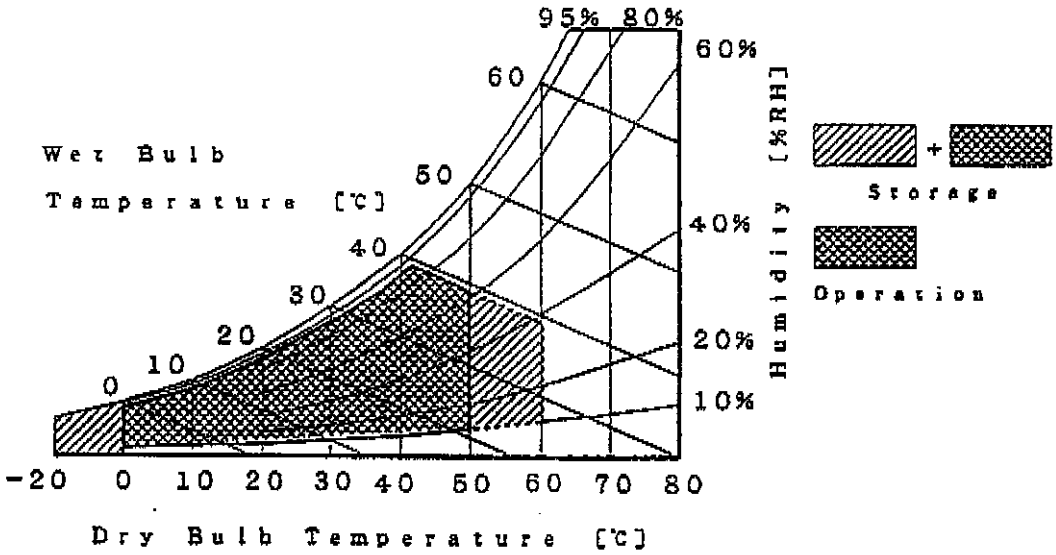
Item	Symbol	Min.	Max.	Unit	Checked Terminal[4]
Supply Voltage	V_{DD}	-0.3	+4.5	V	VDD-GND
Input Voltage of Signals	V_{IN}	-0.3	V_{DD} +0.3	V	R5~R0, G5~G0, B5~B0 NCLK, ENAB-GND
FL Driving Voltage	V_{FL}	0	2	kV_{rms}	
FL Driving Frequency	f_{FL}	0	100	kHz	
Operating Ambient Temperature [2]	T_{OP}	0	+50	°C	
Operating Ambient Humidity [2]	H_{OP}	10	90	%RH	
Storage Temperature [2]	T_{STG}	-20	+60	°C	
Storage Humidity [2]	H_{STG}	10	90	%RH	
Operating Temperature for Panel [3]	—	0	+60	°C	

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

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

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

4) Refer to 2. 4. 4

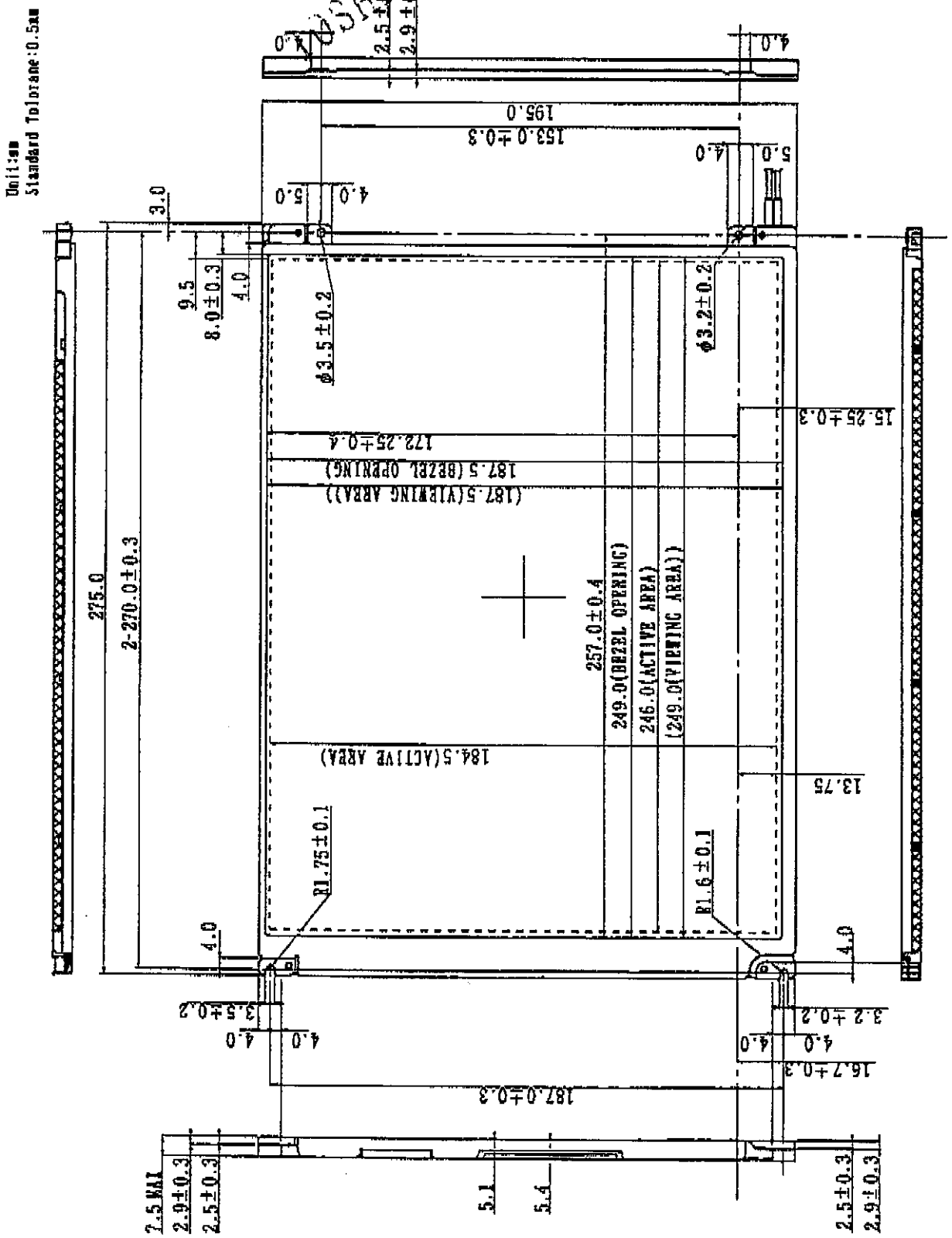


2. 3 Mechanical Specifications

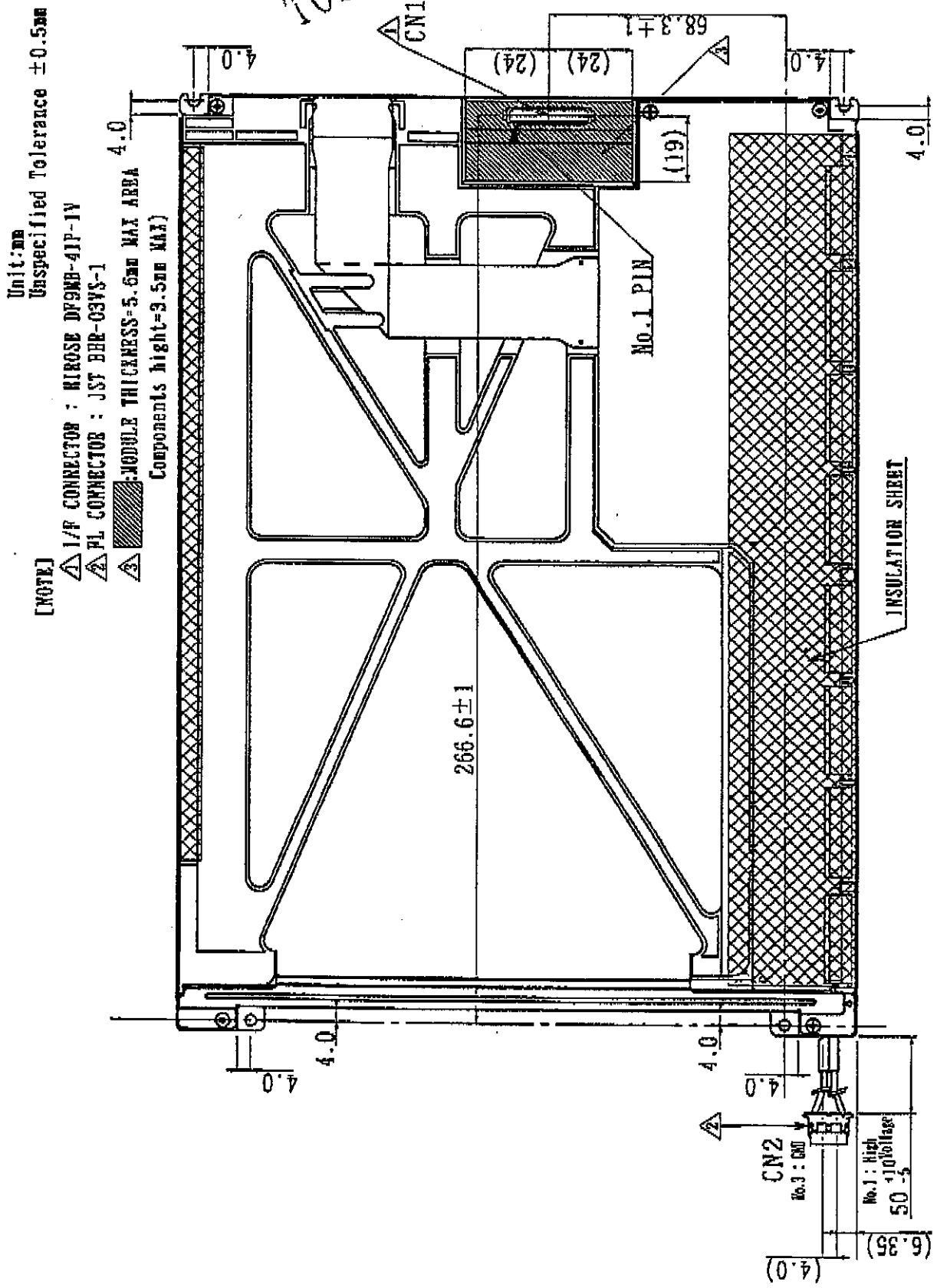
2. 3. 1 Weight

480±20 g

2. 3. 2 Dimensional Outline



(Back figure)



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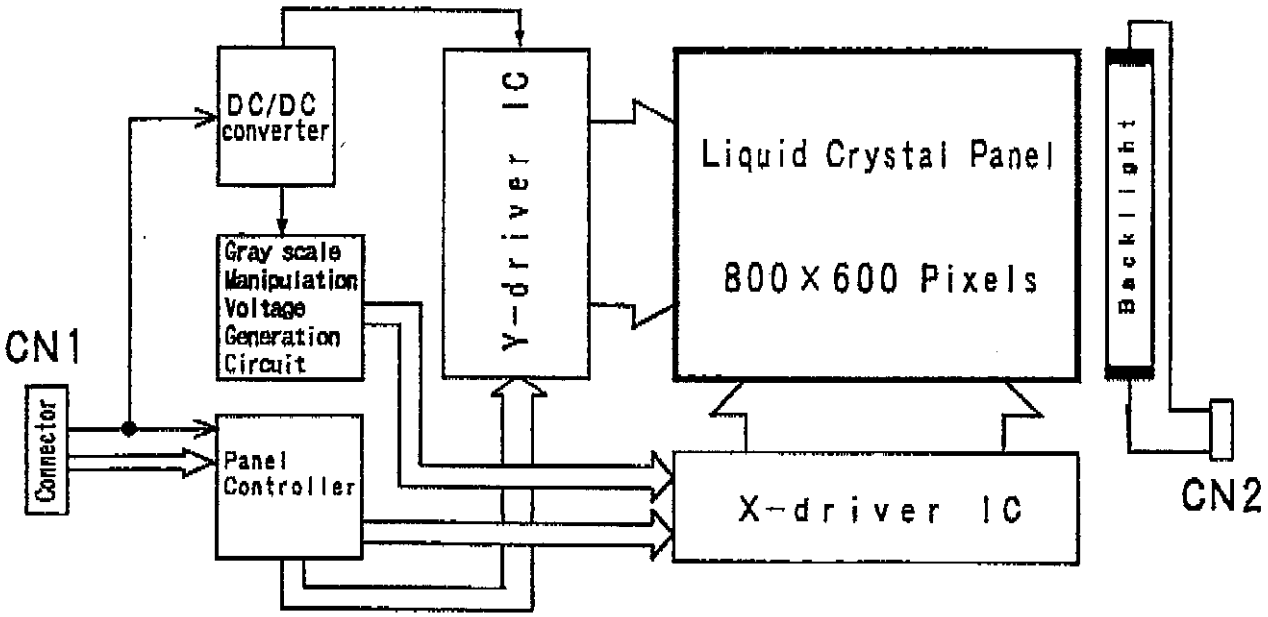
TOSHIBA CORPORATION LIQUID CRYSTAL DISPLAY DIVISION

Date:1997-04-14 No. NR-LTM12C268E-12I

2. 4 Electrical Specifications

2. 4. 1 Circuit Diagram



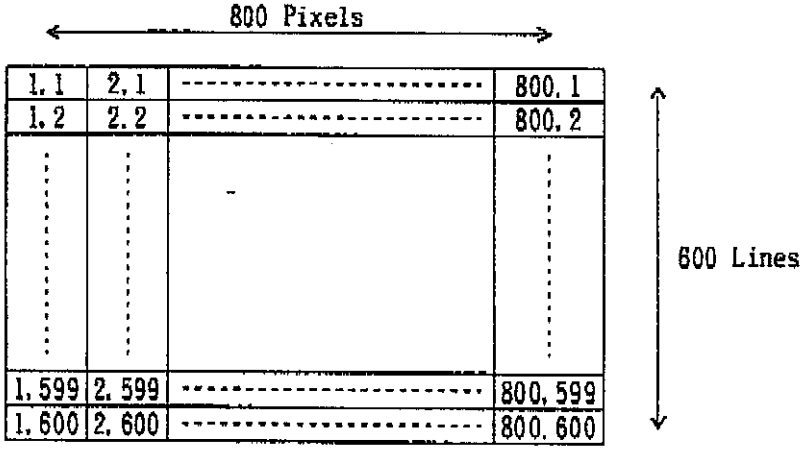
2. 4. 3 Timing Specifications

Item	Symbol	Min.	Typ.	Max.	Unit
Frame Cycle	t1	604×t3 –	625×t3 17.78	628×t3 17.86	– ms
Vertical Display Period	t2	600×t3	600×t3	600×t3	–
Horizontal Scanning Time	t3	844×t5 26.4	1024×t5 28.44	1056×t5 –	– μs
Horizontal Display Period	t4	800×t5	800×t5	800×t5	
Clock Cycle	t5	25.0	27.78	–	ns
Clock "L" Time	t6	7.0	–	–	ns
Clock "H" Time	t7	7.0	–	–	ns
Set up Time	t8	3.0	–	–	ns
Hold Time	t9	10.0	–	–	ns

Note 1) When ENAB is fixed to "H" level or "L" level after NCLK's input, the panel is displayed as a black.
However, it may be occurred a flicker on the display.

Note 2) Don't fix NCLK to "H" or "L" level while the V_{DD}(+3.3V) is supplied.
When NCLK is fixed to "H"or"L" level, while the normal operating signal isn't supplied to LCD panel, this condition results the degradation of the LCD panel display quality.

Note 3) Display Area Address is as follows.



2. 4. 4 Interface Connector

CN1 INPUT SIGNAL (DF9MB-41P-1V / HIROSE ELECTRIC CO., LTD.)

Mating connector : DF9MB-41S-1V or DF9-41S-1V series / HIROSE ELECTRIC CO., LTD.

Terminal No.	Symbol	Function
1	GND	
2	NCLK	SAMPLING CLOCK
3	GND	
4	NC 1)	
5	NC 1)	
6	GND	
7	GND	
8	GND	
9	R0 2)	RED DISPLAY DATA (LSB)
10	R1 2)	RED DISPLAY DATA
11	R2 2)	RED DISPLAY DATA
12	GND	
13	R3 2)	RED DISPLAY DATA
14	R4 2)	RED DISPLAY DATA
15	R5 2)	RED DISPLAY DATA (MSB)
16	GND	
17	GND	
18	GND	
19	G0 2)	GREEN DISPLAY DATA (LSB)
20	G1 2)	GREEN DISPLAY DATA
21	G2 2)	GREEN DISPLAY DATA
22	GND	
23	G3 2)	GREEN DISPLAY DATA
24	G4 2)	GREEN DISPLAY DATA
25	G5 2)	GREEN DISPLAY DATA (MSB)
26	GND	
27	GND	
28	GND	
29	B0 2)	BLUE DISPLAY DATA (LSB)
30	B1 2)	BLUE DISPLAY DATA
31	B2 2)	BLUE DISPLAY DATA
32	GND	
33	B3 2)	BLUE DISPLAY DATA
34	B4 2)	BLUE DISPLAY DATA
35	B5 2)	BLUE DISPLAY DATA (MSB)
36	GND	
37	ENAB	COMPOUND SYNCHRONIZATION SIGNAL
38	NC 1)	
39	VDD	+3.3V POWER SUPPLY
40	VDD	+3.3V POWER SUPPLY
41	NC 1)	

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

Mating connector : SM02(8.0)B-BHS-1 / JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Terminal No.	Symbol	Function
1	VL	CCFL POWER SUPPLY (HIGH VOLTAGE)
2	NC 1)	
3	GL	CCFL POWER SUPPLY (GND SIDE)

Note 1) NC TERMINAL is OPEN. (Don't Use)

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

2. 4. 5 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
					:						:						:			L 3～
					:						:						:			L 60
		H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L 61
		H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L 62
	RED	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	RED L 63
GRAY SCALE of GREEN	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	DARK ↑ ↓ LIGHT	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L 1
		L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L 2
					:						:						:			L 3～
					:						:						:			L 60
		L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L	L 61
		L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L 62
	GREEN	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	GREEN L 63
GRAY SCALE of BLUE	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L 0
	DARK ↑ ↓ LIGHT	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L 1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L 2
					:						:						:			L 3～
					:						:						:			L 60
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	L 61
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L 62
	BLUE	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	BLUE L 63
GRAY SCALE of WHITE & BLACK	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	BLACK L 0
	DARK ↑ ↓ LIGHT	L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L 1
		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L	L 2
					:						:						:			L 3～
					:						:						:			L 60
		H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L 61
		H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L 62
	WHITE	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	WHITE L 63

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

3. Electrical Specifications

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	3.0	3.3	3.6	V	2)
"H" Level Input	V_{IH}	0.8V_{DD}	–	V_{DD}	V	3)
"L" Level Input	V_{IL}	0	–	0.2V_{DD}	V	3)
FL Input Current	I_{FL}	2.5	3.5	4.5	mArms	4)
FL Driving Voltage	V_{FL}	480	530	580	Vrms	I_{FL}=3.5mArms(Reference) 6)
FL Driving Frequency	f_{FL}	40	45	60	kHz	6)
FL Starting Voltage	V_{SFL}	1100	–	1600	Vrms	0℃ 6)

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

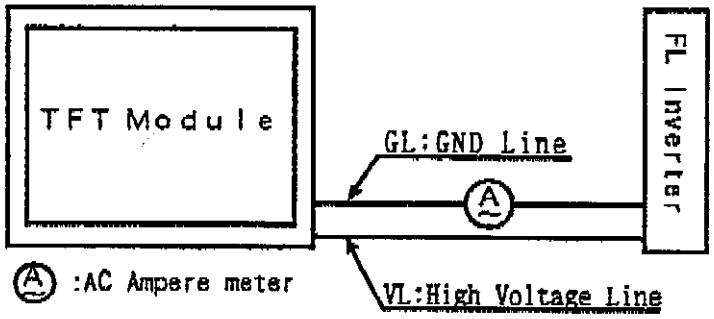
2) Checked Pin Terminal : V_{DD}
(GND : V_{SS}=0V)

3) Checked Pin Terminal : R5~R0, G5~G0, B5~B0, NCLK, ENAB
(GND : V_{SS}=0V)

4) Checked Pin Terminal : VL-GL

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.

6) Measuring Method of I_{FL}:



4. Electrical Characteristics

4.1 Test Conditions

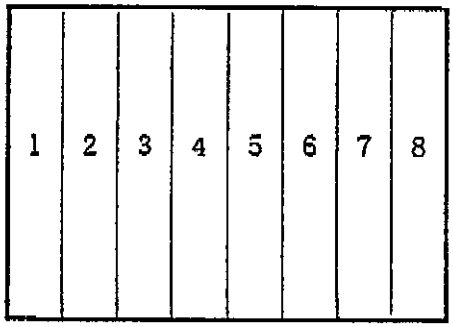
Ambient Temperature : T. 25±5℃
Ambient Humidity : H. 65±20%RH
Supply Voltage : V_{DD} 3.3V
Input Signal : Refer to typical value in "2. 4. 3 Timing Specifications".
FL Input Current : I_{FL} 3.5mArms
FL Driving Frequency : f_{FL} 44kHz

4.2 Specifications

Item	Symbol	Min.	Typ. 1)	Max.	Unit	Remark
Current Consumption	I_{DD}	–	230	350	mA	VDD 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 12.

5.2 Optical Specifications

Item		Symbol	Conditions		Specifications Min.	Typ.	Max.	Unit
Viewing Angle[1]		θ	CR≧10	φ= 180°	10	—	—	deg.
				φ= 0°	20	—	—	deg.
				φ= 90°	30	—	—	deg.
				φ= -90°	30	—	—	deg.
Contrast Ratio		CR	θ= 0°, φ= 0°		100	—	—	—
Response time		t_{ON}	θ= 0°, φ= 0°		—	—	50	ms
		t_{OFF}			—	—	50	ms
Luminance		L	θ=0°, φ=0° Gray Scale Level=L63 (White)		50	70	—	cd/m²
Luminance Uniformity		TUNF	θ=0°, φ=0° Gray Scale Level=L63 (White)		55	—	—	%
Chromaticity	Red	Rx	Gray Scale Level:L63 θ= 0°, φ= 0°		0.52	0.59	0.66	—
		Ry			0.27	0.34	0.41	—
	Green	Gx	Ditto		0.25	0.32	0.39	—
		Gy			0.47	0.54	0.61	—
	Blue	Bx	Ditto		0.08	0.15	0.22	—
		By			0.09	0.16	0.23	—
	White	Wx	Ditto		0.28	0.33	0.38	—
		Wy			0.30	0.35	0.40	—

Note 1:Refer to "12. Measuring Method".

6. Quality

6. 1 Inspection AQL

Total of Major Defects : AQL 0.65 %
Total of Minor Defects : AQL 1.5 %
Sampling Method:MIL-STD-105D(Level Ⅱ)

6. 2 Test Conditions

1) Ambient Temperature : 25±5℃
2) Ambient Humidity : 65±20%RH
3) Illumination : Approximately 500Lx under the fluorescent lamp
4) Viewing Distance : Approximately 30cm by the eyes of the inspector from the module
5) Inspection Angle : $\theta = 0°$ 、 $\phi = 0°$

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. Dimensions 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

6. 4. 2 Specifications

Item	Description				Class
PCB Appearance	* Pattern peeling snapping, electrically short.				Major
	* Repair portion on PCB is not covered by epoxy resign.				Minor
Soldering	* Cold solder joint, lead move when pulled				Major
Bezel, Frame, Connectors	* Distinct stain, rust or scratch.				Minor
Black and White Spots/Lines[1) 2)]	* Line width(mm)	Length(mm)	Acceptable count	Acceptable count	Minor
	W≦0.03		neglect		
	0.03<W≦0.1	L≦0.3	neglect		
	0.03<W≦0.1	0.3<L≦2.1	n≦4		
	0.03<W≦0.1	2.1<L	0		
	0.1<W		(Note 2)		
	* Average diameter(mm)	Acceptable count			
	D≦0.1	neglect			
	0.1<D≦0.4	n≦4			
	0.4<D	0			
Polarizer Dents/ Scratches[1) 3)]	* Line width(mm)	Length(mm)	Acceptable count	n≦10	
	W≦0.01		neglect		
	0.01<W≦0.05	L≦1.0	neglect		
	0.01<W≦0.05	1.0<L≦10	n≦4		
	0.01<W≦0.05	10<L	0		
	0.05<W		(Note 3)		
	* Average diameter(mm)	Length(mm)	Acceptable count		
	D≦0.1		neglect		
	0.1<D≦0.4	L≦1.0	n≦4		
	0.1<D≦0.4	1.0<L	0		
	0.4<D		0		

Note 1) Inspection area should be within viewing area.(249.0x187.5mm²)

Note 2) Lines which are bigger than 0.1mm (0.1<W) shall be judged by "Average Diameter".

Note 3) Scratches which are bigger than 0.05mm (0.05<W) shall be judged by "Average Diameter".

$$\text{Average Diameter } D = \frac{a + b}{2}$$