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A MEMEC Group Company within VEBA Electronics Inc.

REIN Components

No.	LD - 10660
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TECHNICAL LITERATURE

FOR

TFT - LCD module

MODEL No. LQ141X1DG21

The technical literature is subject to change without notice. So, please contact Sharp or its representative before designing your product based on this literature.

ENGINEERING DEPARTMENT 1
TFT DIVISION 2
TFT LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

1. Application

This specifications applies to a color TFT-LCD module, LQ141X1DG21.

◎The device listed in these specification sheets was designed and manufactured for use in OA equipment .

◎In case of using the device for applications such as control and safety equipment for transportation(aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken .

◎Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment(trunk lines), nuclear power control equipment and medical or other equipment for life support .

◎SHARP assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specification sheets .

◎Contact and consult with a SHARP sales representative for any questions about this device .

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). 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 1024×3×768 dots panel with 262,144 colors by 18 bit data signals(6 bit×RGB), two timing signals, +5V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

It is a wide viewing-angle-module (Vertical viewing angle:120° Horizontal viewing angle:140°).

Backlight-driving DC/AC inverter is not built in this module.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	35.8 (14.1") Diagonal	cm
Active area	285.7(H)×214.3 (V)	mm
Pixel format	1024 (H)×768 (V)	pixel
	(1 pixel = R+G+B dots)	
Pixel pitch	0.279 (H)×0.279 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally white	
Unit outline dimensions(Typ)*1	333(W)×251(H)×15.9(D)	mm
Mass	(1200)	g
Surface treatment	Anti-glare and hard-coating 2H	

*1.Note: excluding back light cables.

Outline dimensions is shown in Fig.1

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 Using connector : 53493-060 (MOLEX)

Corresponding connector : 52777-060 (MOLEX)

Pin NO.	Symbol	Function	Remark
1	GND	GND	
2	B5	BLUE data signal (LSB)	
3	GND	GND	
4	B4	BLUE data signal	
5	GND	GND	
6	B3	BLUE data signal	
7	GND	GND	
8	B2	BLUE data signal	
9	GND	GND	
10	B1	BLUE data signal	
11	GND	GND	
12	B0	BLUE data signal (MSB)	
13	GND	GND	
14	G5	GREEN data signal (LSB)	
15	GND	GND	
16	G4	GREEN data signal	
17	GND	GND	
18	G3	GREEN data signal	
19	GND	GND	
20	G2	GREEN data signal	
21	GND	GND	
22	G1	GREEN data signal	
23	GND	GND	
24	G0	GREEN data signal (MSB)	
25	GND	GND	
26	R5	RED data signal (LSB)	
27	GND	GND	
28	R4	RED data signal	
29	GND	GND	
30	R3	RED data signal	
31	GND	GND	
32	R2	RED data signal	
33	GND	GND	
34	R1	RED data signal	
35	GND	GND	
36	R0	RED data signal (MSB)	
37	GND	GND	
38	ENAB	Data enable signal	
39	GND	GND	
40	GND	GND	
41	GND	GND	
42	CK	Clock	
43	GND	GND	
44	GND	GND	
45	GND	GND	
46	B/LON	B/L kick off signal	Output terminal
47	GND	GND	
48	REV	Polar reversal signal	Output terminal
49	GND	GND	
50	GND	GND	
51	GND	GND	
52	GND	GND	
53	GND	GND	
54	GND	GND	
55	GND	GND	
56	GND	GND	
57	Vcc	+5V power supply	
58	Vcc	+5V power supply	
59	Vcc	+5V power supply	
60	Vcc	+5V power supply	

4-2. Backlight driving

CN2,3 Using connector : XHP-9 (JST)

Mating connector : (S9B-XH-A) (JST)

Pin no.	symbol	I/O	function
1	V_{HIGH}	I	Power supply for lamp (High voltage side)
2	NC	—	This is electrically opened.
3	NC	—	This is electrically opened.
4	V_{HIGH}	I	Power supply for lamp (High voltage side)
5	NC	—	This is electrically opened.
6	NC	—	This is electrically opened.
7	V_{LOW}	I	Power supply for lamp (Low voltage side)
8	NC	—	This is electrically opened.
9	V_{LOW}	I	Power supply for lamp (Low voltage side)

5. Absolute Maximum Ratings

5-1 module

Parameter	Symbol	Condition	Ratings	Unit	Remark
Storage temperature	Tstg	—	−25 ～ +60	℃	【Note1】
Operating temperature (Ambient)	Topa	—	0 ～ +50	℃	

【Note1】 Humidity : 95%RH Max. at Ta≦40℃.

Maximum wet-bulb temperature at 39℃ or less at Ta>40℃.

No condensation.

5-2 TFT-LCD panel driving

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage	V_I	Ta=25℃	−0.3 ～ 3.6	V	【Note1】
+5V supply voltage	Vcc	Ta=25℃	0 ～ + 6.0	V	

【Note1】 CK, R0~R5, G0~G5, B0~B5, ENAB

6. Electrical Characteristics

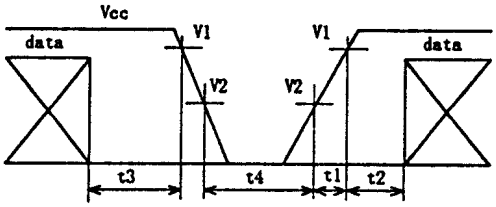
6-1.TFT-LCD panel driving

Ta=25℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Vcc	Supply voltage	Vcc	+4.5	+5.0	+5.5	V	【Note1】
	Current dissipation	Icc	—	(430)	(800)	mA	【Note2】
Permissive input ripple voltage		V_{RF}	—	—	100	mVp-p	
Input voltage (Low)		V_{IL}	GND	—	0.6	V	【Note3】
Input voltage (High)		V_{IH}	2.6	—	3.3	V	【Note3】
Input current (Low)		I_{IL}	—	—	10	μA	V_I=GND 【Note3】
Input current (High)		I_{IH}	—	—	10	μA	V_I=Vcc 【Note3】
Output voltage (High)		V_{OH}	2.6		3.3	V	I_{OH}=|1mA| 【Note4】
Output voltage (Low)		V_{OL}	GND		0.6	V	I_{OH}=|1mA| 【Note4】

【Note2】

On-off conditions for supply voltage



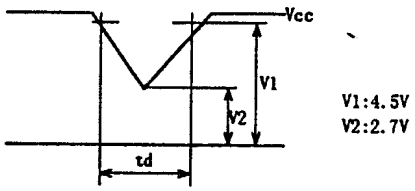
0<t1≦10 ms

0<t2≦10 ms

0<t3≦1 s

t4>1 s

Vcc-dip conditions



1) V2≦Vcc<V1

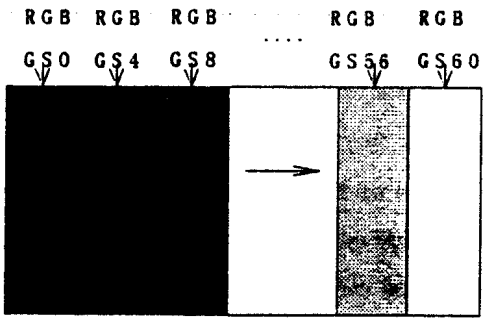
td≦10 ms

2) Vcc<V2

Vcc-dip conditions should also follow the On-off conditions for supply voltage.

【Note2】 Typical current situation : 16-gray-bar pattern.

(Vcc=+3.3V, Gray scale : GS(4n) n=0～15, Gray scale of each color shows below section 8).



【Note3】 CK, R0~R5, G0~G5, B0~B5, ENAB, BLACK, MODE1~4

【Note4】 B/L ON, REV

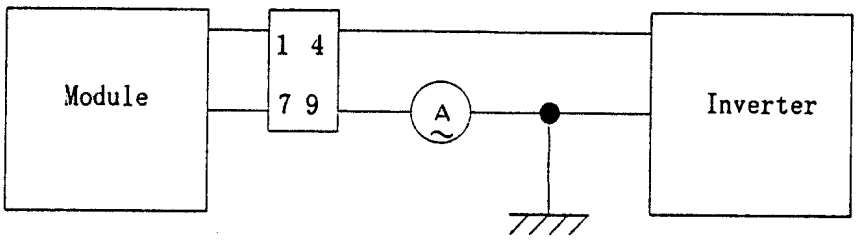
6-2. Backlight driving

. 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.
The value mentioned below is at the case of one CCFT.

Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark	
Lamp current range	I_L	2.5	6.0	7.0	mArms	【Note1】	
Lamp voltage	V_L	—	620'	—	Vrms	Ta=25℃	
Lamp power consumption	P_L	—	3.7	—	W	【Note2】	
Lamp frequency	F_L	20	60	70	kHz	【Note3】	
Kick-off voltage	Vs	—	—	900	Vrms	Ta=25℃	
		—	—	1450	Vrms	Ta=0℃	【Note4】
Lamp life time	T_L	50000	—	—	hour	【Note5】	

【Note1】 A lamp can be light in the range of lamp current shown above .
Maximum rating for current is measured by high frequency current measurement equipment connected to V_{LOW} at circuit showed below . (Note : To keep enough kick-off voltage and necessary steady voltage for CCFT .)
Lamp frequency : 20～60kHz
Ambient temperature : 0～50℃



* 7, 9pin is V_{LOW}

【Note2】 Referential data per one CCFT by calculation ($I_L \times V_L$).
The data dosen't include loss at inverter .

【Note3】 Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, adjust lamp frequency, and keep inverter as far as from module or use electronic shielding between inverter and module to avoid interference.

【Note4】 The voltage above this value should be applied to the lamp for more than 1 second to startup. 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 Ta=25℃ and I_L= 6.0 mArms .

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

② Kick-off voltage at Ta=0℃ exceeds maximum value,(1450) Vrms .

《Note》 The performance of the back light, 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 back light and the inverter (miss-lighting, flicker, etc.) never occurs . 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

Timing diagrams of input signal are shown in Fig.2 .

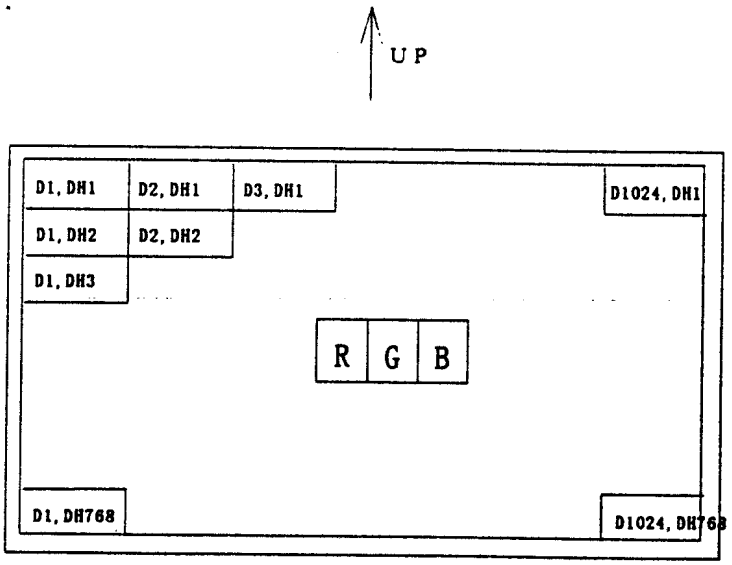
7-1. Timing characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	—	65	66	MHz
	High time	Tch	6			ns
	Low time	Tcl	6			ns
Data	Setup time	Tds	5			ns
	Hold time	Tdh	5			ns
Data enable signal	Setup time	Tes	5			ns
	Horizontal period	TH	16.7	20.7	—	μs
			1070	1344	1790	clock
	Horizontal period (High)	THp	20	1024	1024	clock
	Vertical period	TV	771	806	990	line
	Vertical Blanking	TVb	3	38	222	line

【Note2】 In case of using the long vertical period, the deterioration of display quality, flicker etc., may be occurred.

7-2. Input Data Signals and Display Position on the screen

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.



7-3. B/L ON Signal and REV Signal

B/L On signal is changed from low to high level when the power supply is turned on and module is ready to display.

REV signal is a phase signal which is opposite to a common electrode driving signal.

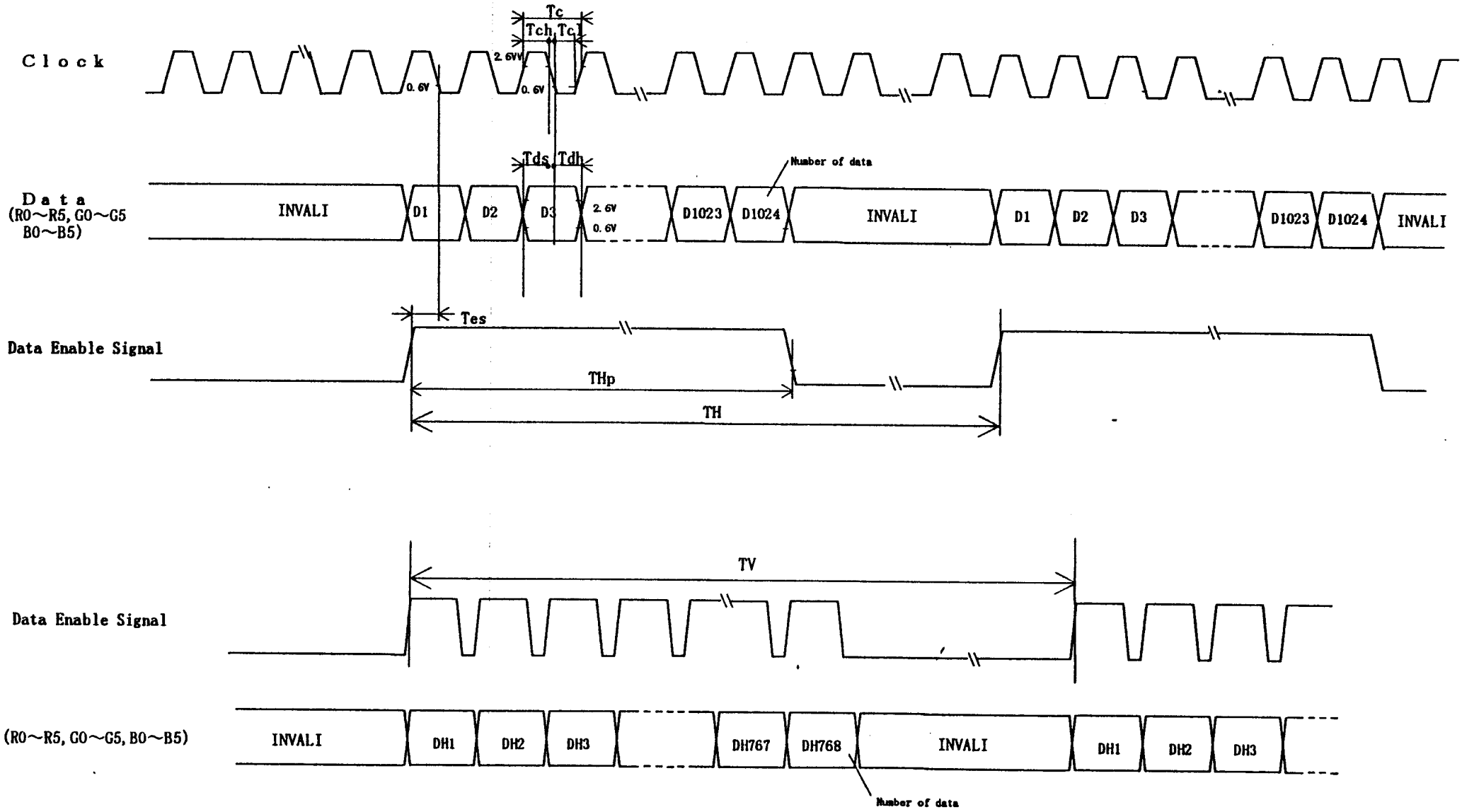


Fig 2 Input Signal Waveforms

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

	Colors & Gray scale	Data signal																	
		Gray Scale	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
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. Optical Characteristics

Ta=25℃, Vcc=+5V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Vertical	θ 11	CR>5	45	60	—	Deg.	【Note1,4】
		θ 12		50	60		Deg.	
	Horizontal	θ 21, θ 22		60	70	—	Deg.	
Contrast ratio		CR	θ =0°	200	300	—		【Note2,4】
Response time	Rise	τ r	θ =0°	—	10	25	ms	【Note3,4】
	Decay	τ d		—	35	50	ms	
Chromaticity of white		x		—	0.313	—		【Note4】
		y		—	0.329	—		
Luminance of white		Y_L		(150)	200	—	cd/m²	I_L =6.0 mArms 【Note4】
White Uniformity		δ_W		—	—	1.45		【Note5】

※ The measurement shall be executed 30 minutes after lighting at rating.

(typical condition : I_L = 6.0 mArms)

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3 below.

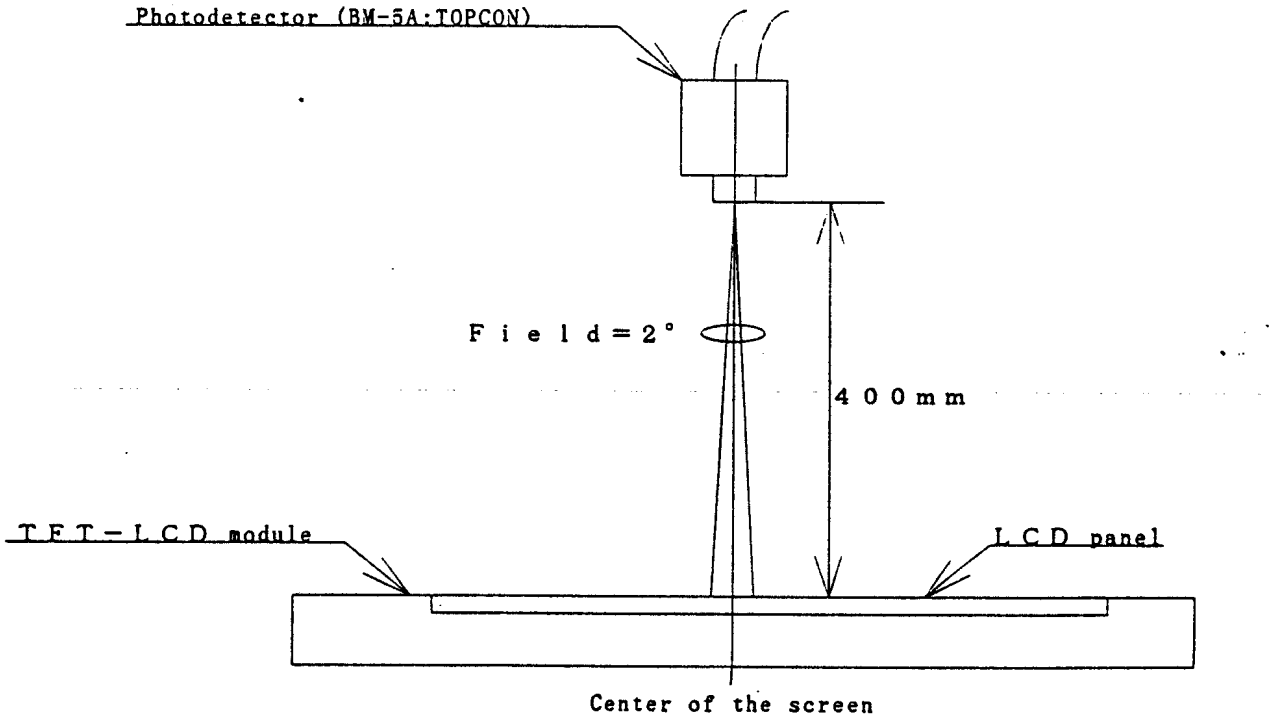
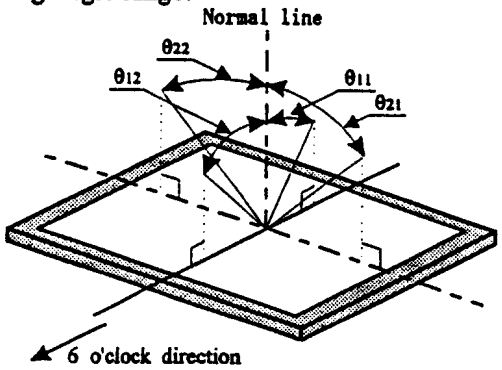


Fig.3 Optical characteristics measurement method

【Note1】 Definitions of viewing angle range:



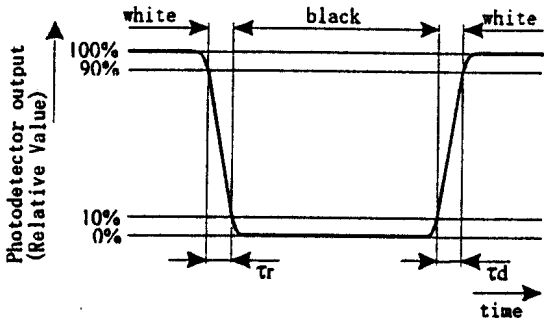
【Note2】 Definition of contrast ratio:

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:

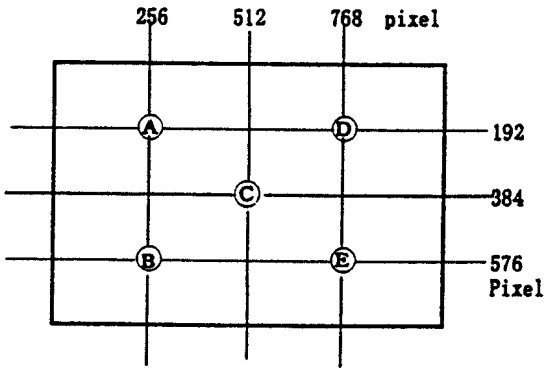
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



【Note4】 This shall be measured at center of the screen.

【Note5】 Definition of white uniformity:

White uniformity is defined as the following with five measurements (A~E).



$$\delta w = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$

10. Display Quality

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

11. 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) Since long contact with water may cause discoloration or spots, wipe off water drop immediately .

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 take the human earth into consideration when handling .

h) 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 action. Blow off 'dust' on the polarizer by using an ionized nitrogen gun, etc.

i) Connect GND to 4 places of mounting holes to minimize against EMI and external noise.

j) There is a circuit board on back side of the module. Please do not put stress on it while designing, constructing, and handling. The circuit board may have danger to be broken, if the stress was on it.

k) Observe all other precautionary requirements in handling general electronic components .

l) When some pressure is added onto the module from rear side constantly , it causes display non-uniformity issue , functional defect , etc . So , please avoid such design .

12. Packing form

a) Piling number of cartons : T.B.D

b) Package quantity in one carton : 5 modules

c) Carton size : T.B.D

d) Total mass of one carton filled with full modules : T.B.D

13. Reliability test items

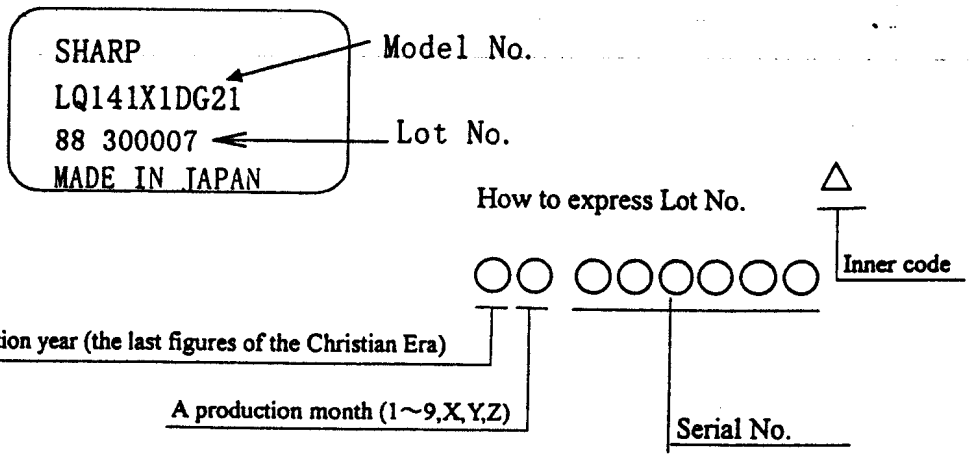
No.	Test item	Conditions
1	High temperature storage test	Ta = 60℃ 240h
2	Low temperature storage test	Ta = -25℃ 240h
3	High temperature & high humidity operation test	Ta = 40℃ ; 95 %RH 240h (No condensation)
4	High temperature operation test	Ta = 50℃ 240h (The panel temp. must be less than 60℃)
5	Low temperature operation test	Ta = 0℃ 240h
6	Vibration test (non- operating)	Frequency : 10 ~ 57Hz/Vibration width (one side):0.075mm : 58~500Hz/Gravity:9.8m/s^2 Sweep time : 11 minutes Test period : 3 hours (1 hour for each direction of X,Y,Z)
7	Shock test (non- operating)	Max. gravity : 490 m/s^2 Pulse width : 11 ms, sine wave Direction : ±X,±Y,±Z once for each direction.

【Result Evaluation Criteria】

Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function .

14. Others

1) Lot No. Label:



2) Adjusting volume have 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.