Thin-Film-Transistor LCD Module
Model: GKTW70SP8D1S0

Acceptance

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Revise Records

Rev.	Date	Contents	Written	Approved
A	2008/09/18	Preliminary Specification	Kobe Su	David Lee

Special Notes

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

Contents

1. General Description and Features

GKTW70SP8D1S0 is a transmissive type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. Graphics and texts can be displayed on a WVGA 800 (W) x 3 x 480 (H) dots (16:9 aspect ratio) with 262,144 colors by supplying 18 bits data signal (6bits/each color). The following table described the features of. GKTW70SP8D1S0

1.1 Features

- Transmissive and back-light with 27 LEDs are available.
- TN (Twisted Nematic) mode.
- Digital RGB (6bits/color) data transfer.
- Data enable mode.
- Data inverted function for reducing EMI.

1.2 LCD Module

Item	Specification	Unit
Screen Size	7.0 inches	Diagonal
Display Resolution	800 (H) x 480 (V)	Pixel
Active Area	152.40 (H) x 91.44 (V)	mm
Outline Dimension	165.00 (H) x 104.00 (V) x 6.55 (T)	mm
Display Mode	Normally white mode/ Transmissive	--
Pixel Arrangement	R,G,B Vertical Stripe	--
Pixel Size	190.5 x 190.5	um
Display Color	Full Colors	--
Viewing Direction	6 o'clock	--
Input Interface	Digital RGB (6bits/color) Data Transfer	--
TFT Driver	Source: HX8232-A02x3, Gate: HX8643Ax1	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	165.00	--	mm	
	Vertical (V)	--	104.00	--	mm	
	Thickness (T)	--	6.55	--	mm	(1)
Weight		--	155	--	g	--

Note (1) Exclude Component . Refer to the Outline Dimension Drawing as attached.

3. Electrical Specifications

3.1 Absolute Max. Ratings

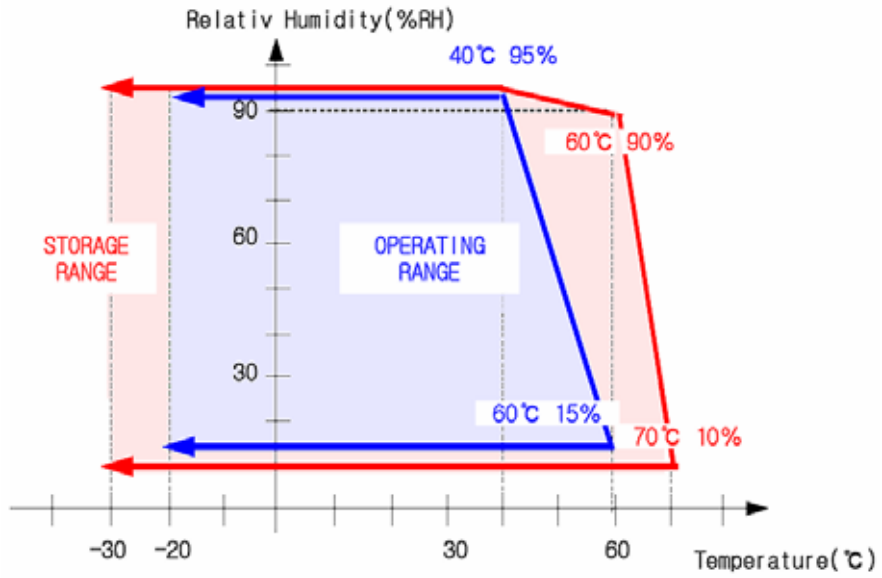
3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-20	70	°C	(1)
Operating temperature	T_{OPR}	-10	60	°C	(1,2,3)

Note (1) 95 % RH Max. (40 °C ≥ Ta). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.



Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

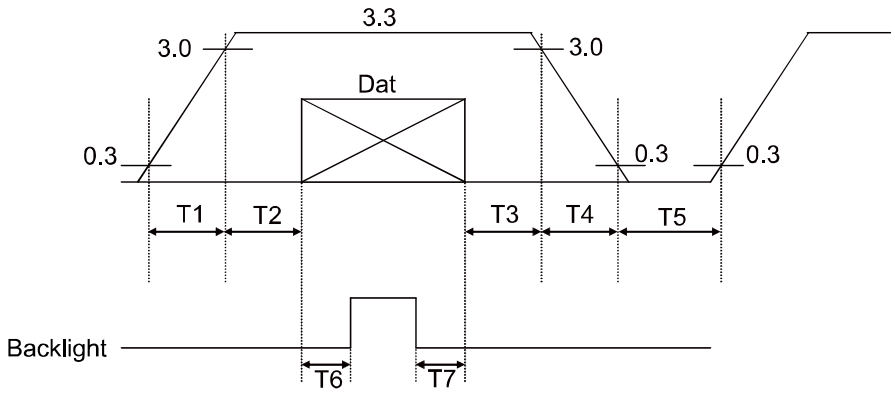
Note (3) Only operation is guarantied at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.1.2 Electrical Absolute Maximum Ratings

(V_{SS}=GND=0)

Parameter	Symbol	Min.	Max.	Unit	Remark
Power supply voltage	V_{CC}	-0.3	5.0	V	
Signal input voltage	R0-R5,G0-G5, B0-B5,DCLK,DE	-0.3	Vcc+0.3	V	--
Permissive input ripple voltage	V_{RF}	--	100	mVp-p	V_{CC}=+3.3V

Display On/Off Sequence :



Data: DCLK, R0 ~ R5, G0 ~ G5, B0 ~ B5, DE

T1≤10ms, 50ms≤T2, 0<T3≤50ms, 0<T4≤10ms, 1s≤T5, 200ms≤T6, 200ms≤T7

3.2 Electrical Characteristics

3.2.1 DC Electrical Characteristics of the TFT LCD

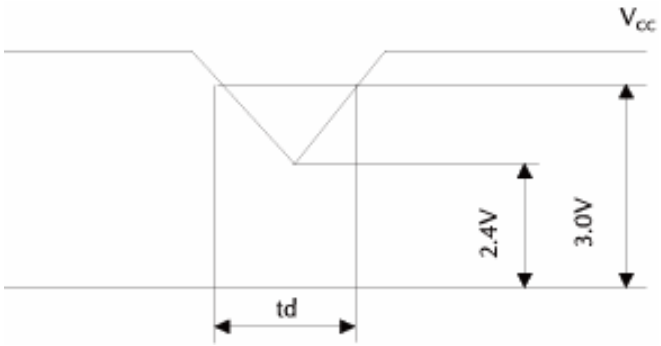
(Ta=25±2°C, V_{SS}=GND=0)

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VCC	3.0	3.3	3.6	V	Note 1
Input Voltage for logic	H Level	VIH	2.0	-	VCC	V	
	L Level	VIL	0	-	VCC	V	
Power Supply current		ICC		150	200	mA	Note 2

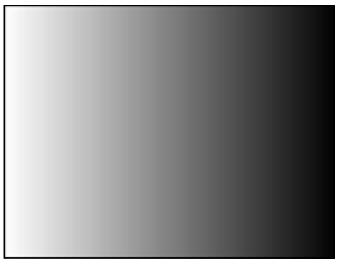
Note1: Vcc-dip conditions

Vcc-dip conditions should also follow the Vcc-turn-on conditions

Td ≤ 10ms



Note2: fv =60Hz , Ta=25°C , Display pattern : 64 Gray pattern



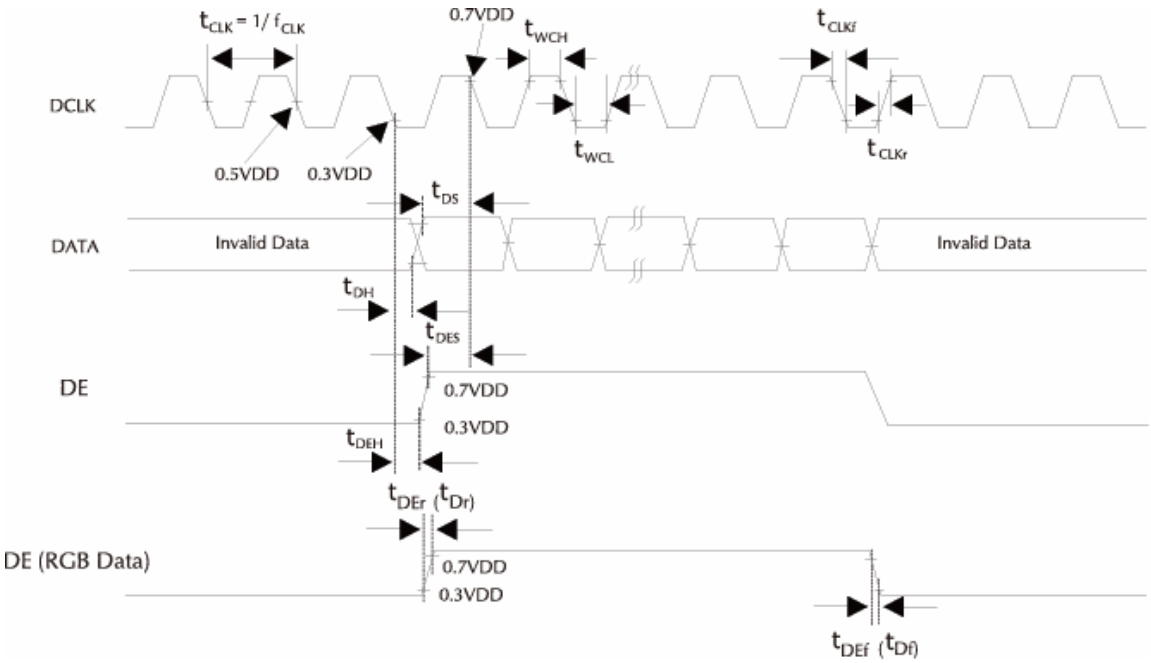
3.3 AC Timing Characteristic of The LCD

3.3.1 Timing Condition (DE only mode)

Signal	Parameter	Symbol	Min.	Typ.	Max.	Unit.	Remark
DCLK	DCLK period	t_{CLK}	31	37.0	40.0	ns	
	Frequency	f_{CLK}	25	27	32.2	MHz	
	DCLK High plus width	t_{WCH}	6	-	-	ns	
	DCLK Low plus width	t_{WCL}	6	-	-	ns	
DATA	Data setup time	t_{DS}	5	-	-	ns	
	Data hold time	t_{DH}	10	-	-	ns	
	Rise/Fall Time	t_{Dr}, t_{Df}			10	ns	
DE	Setup Time	t_{DES}	5			ns	
	Hold Time	t_{DEH}	10			ns	
	Rise/Fall Time	t_{DEr}, t_{DEf}			16	ns	
	Horizontal Period	t_{HP}	850	900	950	t_{CLK}	
	Horizontal Valid	t_{HV}	800				
	Horizontal Blank	t_{HBK}	50	100	150		
	Vertical Period	t_{VP}	490	500	550	t_{HP}	
	Vertical Valid	t_{VV}	480				
	Vertical Blank	t_{VBK}	10	20	40		
	Vertical Frequency	f_V	55	60	65	Hz	

3.3.2 Timing Characteristic

3.3.2.1 DE and RGB Input Timing



3.4 Back-Light Unit

The Back-light system is an edge-lighting type with 27 white LED (Light Emitting Diode)s. The characteristics of 27 white LEDs are shown in the following tables.

(Ta= Room Temp)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Voltage	Vf	(9.3)	-	(9.9)	V	(1)
Power Consumption	P_{BL}(Vf X IB)	(1674)	-	(1782)	mW	

Note (1) LEDS in 3 series x 9 parallel type. IB condition=180mA.

4. Optical Characteristics

4.1 Optical characteristic of the LCD

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment: BM-5A, BM-7

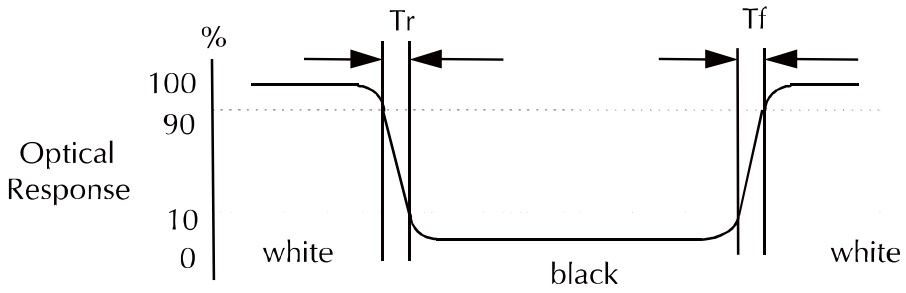
Item		Symbol	Condition	Min	Type	Max	Unit	Note
Brightness				400	500	--	cd/m^2	
Response time		T_r	θ=0°	-	15	20	ms	.
		T_f		--	25	35	ms	
Contrast ratio		CR	At optimized viewing angle	(350)	(400)	--	--	
Color Gamut		NTSC %	--	--	50	--	%	
Color Chromaticity (CIE 1931)	Red	R_x	θ=0° Normal Viewing Angle	0.562	0.612	0.662	--	
		R_y		0.294	0.344	0.394		
	Green	G_x		0.258	0.308	0.338	--	
		G_y		0.496	0.546	0.596		
	Blue	B_x		0.090	0.140	0.190	--	
		B_y		0.080	0.130	0.180		
	White	Wx		0.257	0.307	0.357	--	
		Wy		0.299	0.349	0.399		
Viewing Angle (6H)	Hor.	θ_R	CR≥10	55	65	--	Degree	
		θ_L		55	65	--		
	Ver.	ϕ_H		40	50	--		
		ϕ_L		50	60	--		

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

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

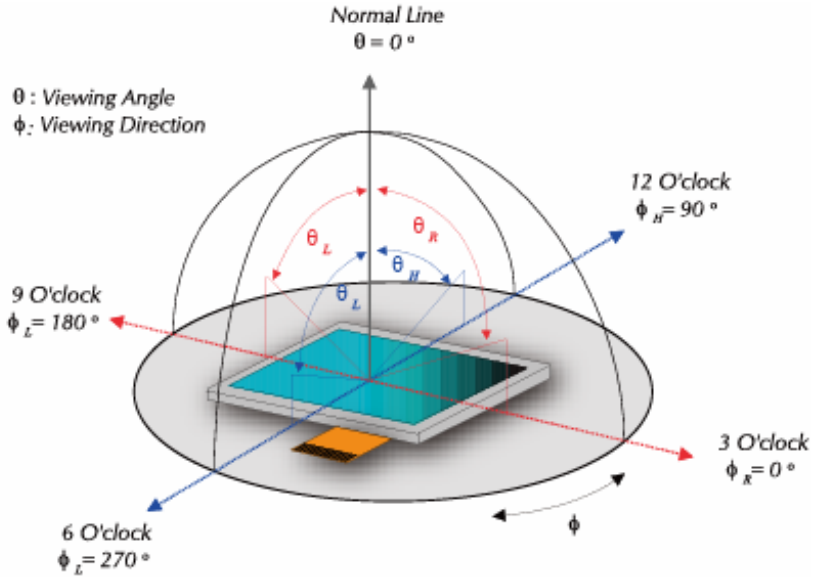


c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

e. View Angle



f. Definition of Luminance of White: Luminance of white at the center points

Light Source of Back-Light Unit	LED Type

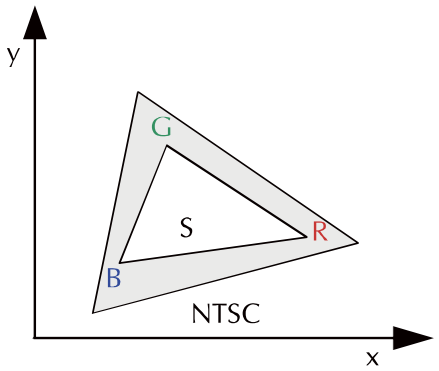
g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 5-points}}{\text{Max. luminance of white among 5-points}}$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

Color Gamut : NTSC(%) = (RGB Triangle Area / NTSC Triangle Area) x 100



4.2 Optical characteristic of the Back-Light

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Luminance (9 points AVG.)	IV	--	7000	--	cd/m^2	--
Color	--		White		--	--
Uniformity	U	70	80	--	%	--
Lighting type	Side Lighting					

Note (1) The measurement instrument is BM-7 luminance color-meter the measuring distance is 500 ± 20mm.

The uniformity definition (Min. brightness / Max. brightness) x 100%.

5. Touch Screen Panel

5.1 Touch Screen Panel Specifications

5.1.1 Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	260	-	800	Ω	X(Top Layer)
	200	-	400	Ω	Y(Button Layer)
Insulation resistance	20	-	-	MΩ	DC 25V
Voltage	-	5.0	7.0	V	DC
Chattering	-	-	10	ms	100kΩ pull-up
Transparency	-	82	-	%	Non-glare

Caution (1) : Do not operate it with a thing except a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

5.1.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation force	-		80	g	(1)
Durability-surface scratching	Write 100,000	-	-	characters	(2)
Durability-surface pitting	1,000,000	-	-	touches	(3)
Surface hardness	3	-	-	H	JIS K5400,ASTM D3363

Note (1) Stylus pen Input : R0.8mm polyacetal pen or Finger

Note (2) Measurement for Surface area - Scratch 100,000 times straight line on the Film with a stylus change every 20,000times

- Force : 150gf
- Speed : 100mm/sec
- Stylus : R0.8 polyacetal tip

Note (3) Pit 1,000,000 times on the Film with a R8.0 silicon rubber.

- Force : 250gf
- Speed : 3times/sec

6. I/O Terminal

6.1 Pin Assignment

Pin No.	Symbol	I/O	Function	Remark
1	GND	--	Ground	
2	GND	I	Ground	
3	NC	I	No Connection	
4	VCC	I	Power Supply	
5	VCC	I	Power Supply	
6	VCC	I	Power Supply	
7	VCC	I	Power Supply	
8	NC	I	No Connection	
9	DE	I	Data Enable Timing Signal	
10	GND	--	Ground	
11	GND	--	Ground	
12	GND	--	Ground	
13	B5	I	Blue data signal (MSB)	
14	B4	I	Blue data signal	
15	B3	I	Blue data signal	
16	GND	--	Ground	
17	B2	I	Blue data signal	
18	B1	I	Blue data signal	
19	B0	I	Blue data signal (LSB)	
20	GND	--	Ground	
21	G5	I	Green data signal (MSB)	
22	G4	I	Green data signal	
23	G3	I	Green data signal	
24	GND	--	Ground	
25	G2	I	Green data signal	
26	G1	I	Green data signal	
27	G0	I	Green data signal (LSB)	
28	GND	--	Ground	
29	R5	I	Red data signal (MSB)	
30	R4	I	Red data signal	
31	R3	I	Red data signal	
32	GND	--	Ground	
33	R2	I	Red data signal	
34	R1	I	Red data signal	

35	R0	I	Red data signal (LSB)	
36	GND	--	Ground	
37	GND	--	Ground	
38	DCLK		Data Clock	
39	GND	--	Ground	
40	GND	--	Ground	

I: Input, O: Output, P: Power

Remarks:

1) NC Pin must be retained; this pin can't contact GND or other signal.
2) GND Pin must ground contact, can not be floating.

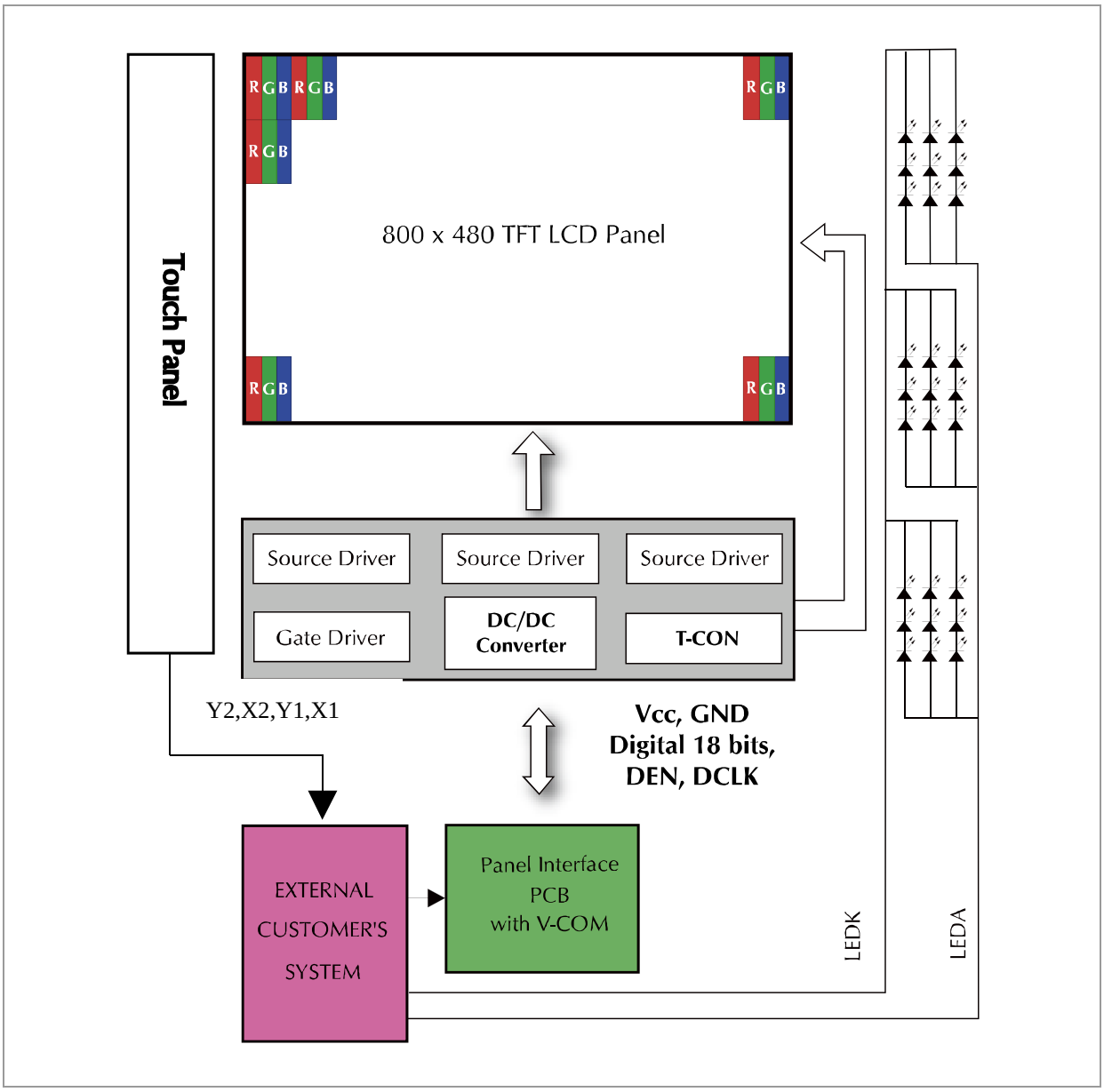
6.2 Back-light Unit (BLU)

Pin No.	Symbol	Function	Remark
1	LEDA	Power Supply for LED backlight	RED
2	LEDK	GND for LED backlight	BLACK

6.3 Touch Screen (TSP)

Pin No.	Symbol	Function	Remark
1	Y2	Touch Panel Top Side	
2	X2	Touch Panel Right Side	
3	Y1	Touch Panel Bottom Side	
4	X1	Touch Panel Left Side	

6.4 Block Diagram



6.5 Displayed Color and Input Data

	Color & Gray Scale	Data Signal																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	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
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(61)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(31)	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(1)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(61)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(31)	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(1)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(0)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

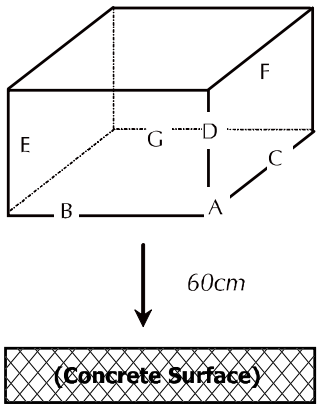
0 : Low level voltage, 1 :High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. With the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

7. Test

No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.
Temperature: 20±5°C.
Humidity: 65±5%RH.
Tests will be not conducted under functioning state.

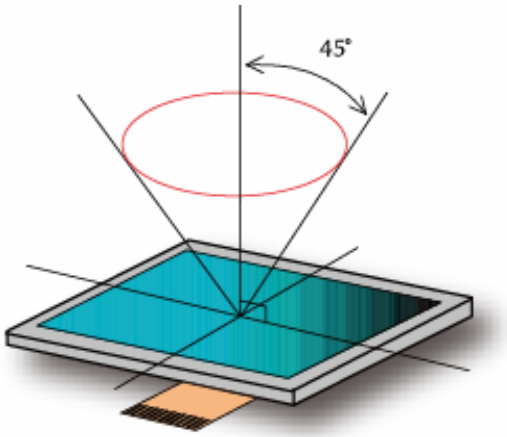
No.	Parameter	Condition	Notes
1	High Temperature Operating	60°C±2°C, 120hrs (Operation state).	
2	Low Temperature Operating	-10°C±2°C, 120hrs (Operation state).	1
3	High Temperature Storage	70°C±2°C, 120hrs.	2
4	Low Temperature Storage	-20°C±2°C, 120hrs.	1,2
5	Damp Proof Test	40°C±2°C, 90~95%, 120hrs.	1,2
6	Vibration Test	Total fixed amplitude: 1.5mm. Vibration Frequency: 10~55Hz. One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	3
7.	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  *Dropping method corner dropping:* *A corner: Once edge dropping.* *B, C, D edge: Once face dropping.* *E, F, G face: Once.*	

Notes: 1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. Vibration test will be conducted to the product itself without putting I in a container.

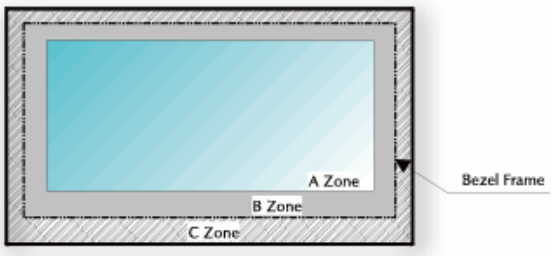
8. Appearance

8.1 Inspection

The distance between the eyes and the sample shall be more than 30cm. All directions for inspecting the sample should be within 45° against perpendicular line.



Definition of Applicable Zones



A Zone : Active display area, B Zone : Area from outside of "A Zone" to validity viewing area

C Zone : Rest parts, A Zone + B Zone = Validity viewing area

(a) Operating Inspection

The function and appearance shall be inspected in the condition of

- Under 750 Lux or over light …….. Reflective Type.
- Using over Backlight unit …….. Transflective Type, Transmissive Type.

Condition of judgment

In case of no gradation display it judges by applied On/Off voltage or optimal contrast.

In case of gradation display it judges by contrast that the bad point is able to confirm best.

(b) Appearance Inspection

The appearance shall be inspected in the condition of

- under 500 lx or over light …….. Reflective Type.
- Using over Backlight unit …….. Transflective Type, Transmissive Type.

(c) Inspection Environment

Inspection environment it carried out with 250 Lux or less in principles.

9. Precautions

9.1 Operation

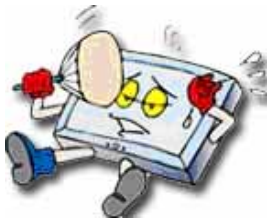
Burn-in sometimes happens when the same character was displayed at along time. Therefore, to prevent Burn-in, it is recommended to set up a Screen-saver function.

9.2 Safety

The liquid crystal in the LCD is poisonous, DO NOT put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

9.3 Handling

	a. The LCD module shall be installed flat, without twisting or bending. b. COF or FPC has narrow pattern width, so easily become open circuit by external force. DO NOT apply pressure to COF or FPC especially in bending area.
	c. To avoid damage in appearance or malfunction, DO NOT subject the module to mechanical shock or to excessive force on its surface.
	d. The polarizer attached to the display is very easy to damage, handle it with care to avoid scratching.
	e. To avoid contamination on the display surface, DO NOT touch the display surface with bare hands. f. Provide a space so that the LCD module does not come into contact with other components.

	g. To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) to keep appropriate space between them.
	h. Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
	i. Property of semiconductor devices may be affected when they are exposed to light possibly resulting in malfunctioning of the ICs. To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.
	j. Strong light exposure causes degradation of color filter. It may not recover
	k. DO NOT contact with water to avoid Metal corrosion. l. When it is not in use, the screen must be turned off or the pattern must be frequently changed by a screen saver. If it displays the same pattern for a long period of time, brightness down/image sticking may develop due to the LCD structure.
	m. Never disassemble LCD product under any circumstances. If unqualified operators or users assemble the product after disassembling it, it may not function or its operation may be seriously affected.

9.4 Static Electricity

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge.

	a. The LCD module shall be installed flat, without twisting or bending. Ground soldering iron tips, tools and testers when they operate. b. Ground your body when handling the products. c. DO NOT apply voltage to the input terminal without applying power supply. d. DO NOT apply voltage that exceeds the absolute maximum rating. e. Store the products in an anti-electrostatic container. f. Peel off protect tape, attached to polarizer, slowly to minimize ESD damage.

9.5 Storage

	Store the products in a dark place at +5 ~ +25 degree C, low humidity (50%RH or less). DO NOT store the products in an atmosphere containing organic solvents or corrosive gases.

9.6 Cleaning

	a. DO NOT wipe the polarizer with dry cloth, as it might cause scratch. b. Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

9.7 Waste

	When dispose of LCD module, manage it at the production waste according to the relevant laws and regulations.

10. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

2 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

3 We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

4 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. SGD-origin longer than one year from SGD production.

11. Dimensional Outlines