

ALC-070004-02-1

~ 7" Enhanced High Bright LCD with
LED Backlight for Outdoor Displays

2012/4/2

Engineering Specifications v.1.0

() Preliminary Specifications

() Final Specifications

[This specification is subject to
change without notice.]

Company Confidential

ROHS

Approved by	Checked by	Prepared by
		

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RECORD OF REVISION

Version	Date	Page	Original Description	New Description	ECN#
0.0	2011/9/23	All	First draft	All	N/A
1.0	2012/4/2	All	Final version		

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ALC-070004-02-1

ENGINEERING SPECIFICATIONS

1. General Description and Features

ALC-070004-02-1, 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:

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

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 5.70 (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	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	165.00	--	mm	
	Vertical (V)	--	104.00	--	mm	
	Thickness (T)	--	5.70	--	mm	(1)
	Thickness (T)	--	7.1	--	mm	(2)
Weight		--	(145)	--	g	--

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

(2) Include Components. 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.

($T_a=25\pm 2^\circ\text{C}$, $V_{SS}=\text{GND}=0$)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	80	$^\circ\text{C}$	(1)
Operating temperature	T_{OPR}	-20	70	$^\circ\text{C}$	(1,2,3)

Note (1) 95% RH Max. ($40^\circ\text{C} \geq T_a$). Maximum wet-bulb temperature at 39°C or less. ($T_a > 40^\circ\text{C}$) 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

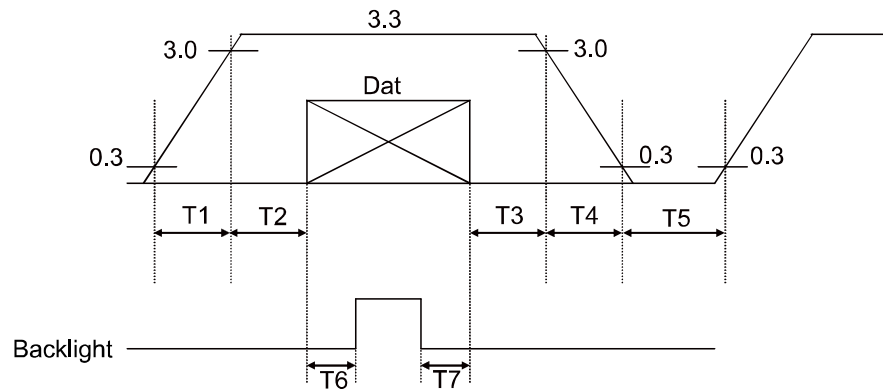
Note (3) Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at $+25^\circ\text{C}$.

3.1.2 Electrical Absolute Maximum Ratings

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

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	$V_{CC}+0.3$	V	--
Permissive input ripple voltage	V_{RF}	--	100	mVp-p	$V_{CC}=+3.3\text{V}$

Display On/Off Sequence:



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

$T1 \leq 10\text{ms}$, $50\text{ms} \leq T2$, $0 < T3 \leq 50\text{ms}$, $0 < T4 \leq 10\text{ms}$, $1\text{s} \leq T5$, $200\text{ms} \leq T6$, $200\text{ms} \leq T7$

3.2 Electrical Characteristics

3.2.1 DC Electrical Characteristics of the TFT LCD

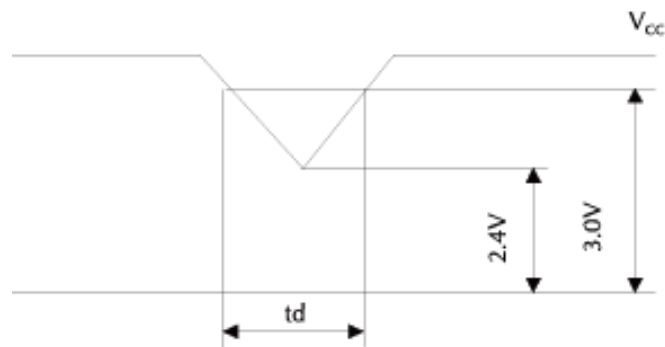
($T_a=25\pm 2^\circ\text{C}$, $V_{SS}=\text{GND}=0$)

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	$0.7 \times V_{CC}$	-	VCC	V	
	L Level	0	-	$0.3 \times V_{CC}$	V	
Power Supply current	ICC		(150)	(200)	mA	Note 2

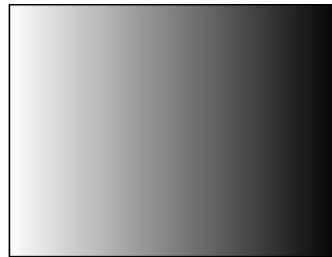
Note1: Vcc-dip conditions

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

$T_d \leq 10\text{ms}$



Note2: $f_v = 60\text{Hz}$, $T_a = 25^\circ\text{C}$, Display pattern : 64 Gray pattern



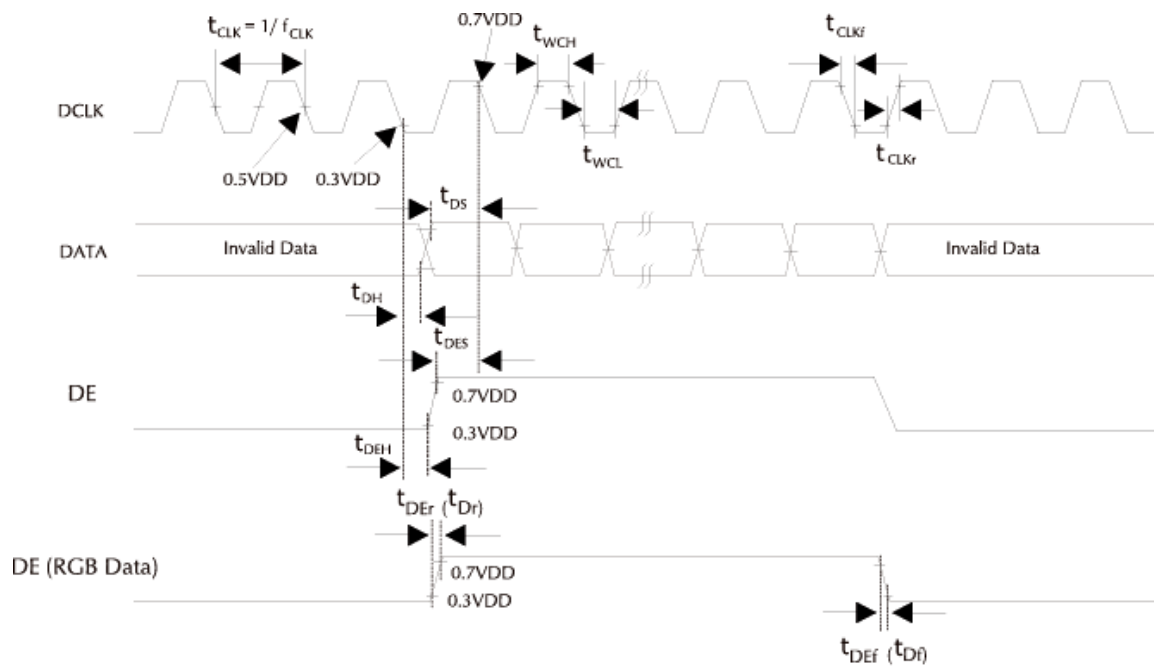
3.3 AC Timing Characteristic of The LCD

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 Backlight Unit

The Backlight 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	V_F	-	(9.6)	-	V	
Forward Current	I_F	-	180	-	mA	(1)
Power Consumption	P_{BL}	-	1782	-	mW	(2)
LED Life Time		(40,000)			Hr	(3)

Note (1) LEDs in 3 series x 9 parallel type.

(2) Where $I_F = 180\text{mA}$, $V_F = 9.6$, $P_{BL} = V_F \times I_F$

(3) The environmental conducted under ambient air flow, at $T_a = 25 \pm 2^\circ\text{C}$, $60\%RH \pm 5\%$

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.

Measuring equipment: BM-7A

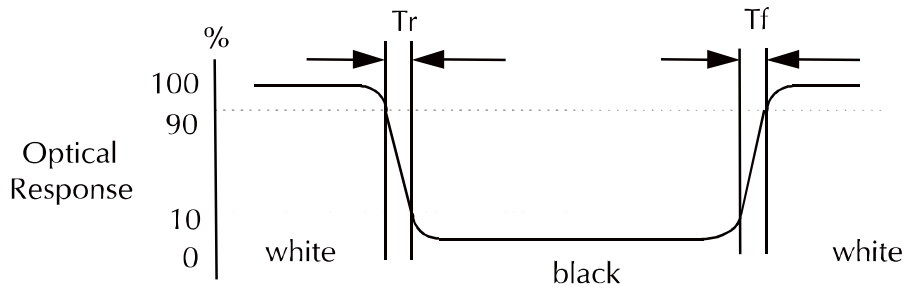
Item	Symbol	Condition	Min	Type	Max	Unit	Note
Brightness			550	600	--	cd/m ²	
Response time	T_r	$\theta = 0^\circ$	-	10	20	ms	.
	T_f		--	15	30	ms	
Contrast ratio	CR	At optimized viewing angle	(350)	(400)	--	--	
Color Chromaticity (CIE 1931)	Red	R_x	$\theta = 0^\circ$ Normal Viewing Angle	0.565	0.615	0.665	--
		R_y		0.295	0.345	0.395	
	Green	G_x		0.266	0.316	0.366	--
		G_y		0.493	0.544	0.593	
	Blue	B_x		0.088	0.138	0.188	--
		B_y		0.101	0.151	0.201	
	White	W_x		0.266	0.316	0.366	--
		W_y		0.295	0.345	0.395	
Viewing Angle (δH)	Hor.	θ_R	CR \geq 10	55	65	--	Degree
		θ_L		55	65	--	
	Ver.	ϕ_U		45	55	--	
		ϕ_D		55	65	--	

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”.

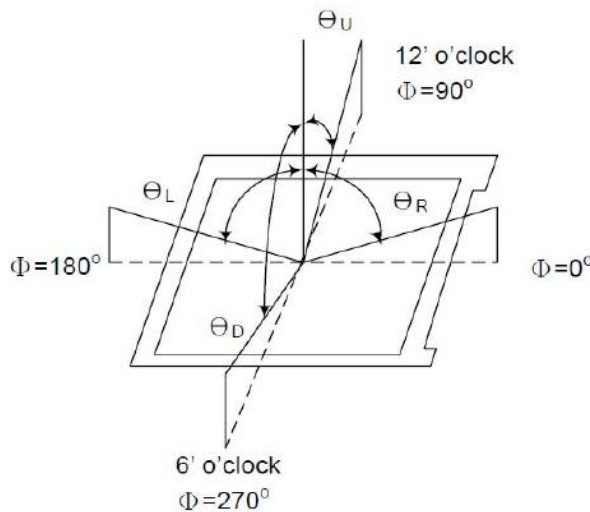


c. Definition of contrast ratio:

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

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
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g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100\%$$

5. I/O Terminal

5.1 Pin Assignment

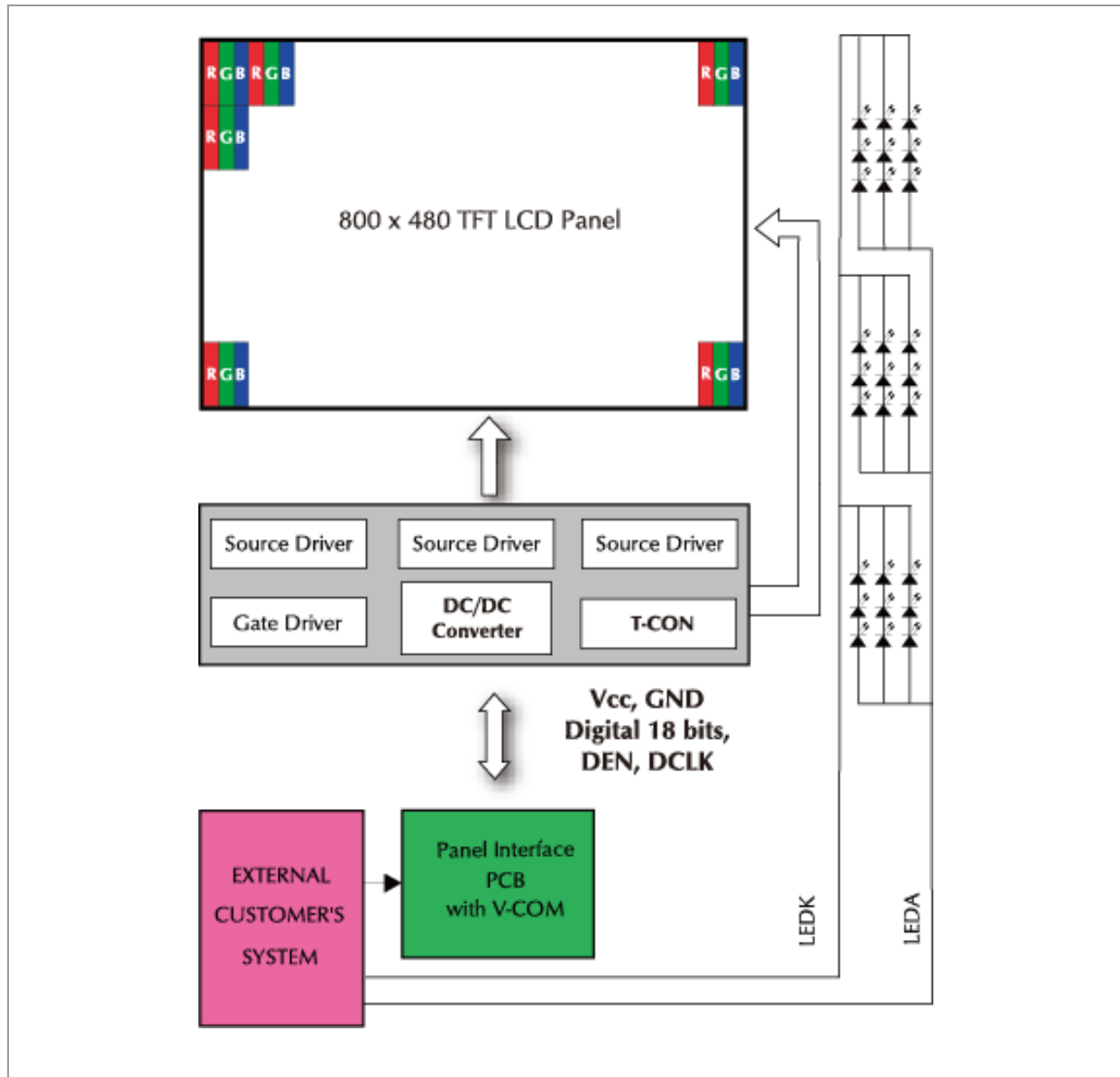
Pin No.	Symbol	I/O	Function	Remark
1	GND	P	Ground	
2	GND	P	Ground	
3	NC	--	No Connection	
4	VCC	P	Power Supply	
5	VCC	P	Power Supply	
6	VCC	P	Power Supply	
7	VCC	P	Power Supply	
8	VCC	P	Power Supply	
9	DE	I	Data Enable Timing Signal	
10	GND	P	Ground	
11	GND	P	Ground	
12	GND	P	Ground	
13	B5	I	Blue data signal (MSB)	
14	B4	I	Blue data signal	
15	B3	I	Blue data signal	
16	GND	P	Ground	
17	B2	I	Blue data signal	
18	B1	I	Blue data signal	
19	B0	I	Blue data signal (LSB)	
20	GND	P	Ground	
21	G5	I	Green data signal (MSB)	
22	G4	I	Green data signal	
23	G3	I	Green data signal	
24	GND	P	Ground	
25	G2	I	Green data signal	
26	G1	I	Green data signal	
27	G0	I	Green data signal (LSB)	
28	GND	P	Ground	
29	R5	I	Red data signal (MSB)	
30	R4	I	Red data signal	
31	R3	I	Red data signal	
32	GND	P	Ground	
33	R2	I	Red data signal	
34	R1	I	Red data signal	
35	R0	I	Red data signal (LSB)	
36	GND	P	Ground	
37	GND	P	Ground	
38	DCLK	I	Data Clock	
39	GND	P	Ground	
40	GND	P	Ground	

I: Input, O: Output, P: Power

Remarks:

- 1) GND Pin must ground contact, cannot be floating.

5.2 Block Diagram



5.3 Backlight Unit (BLU)

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

5.4 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.

6. Reliability

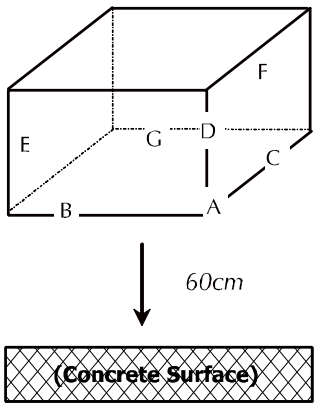
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: 20±5°C.

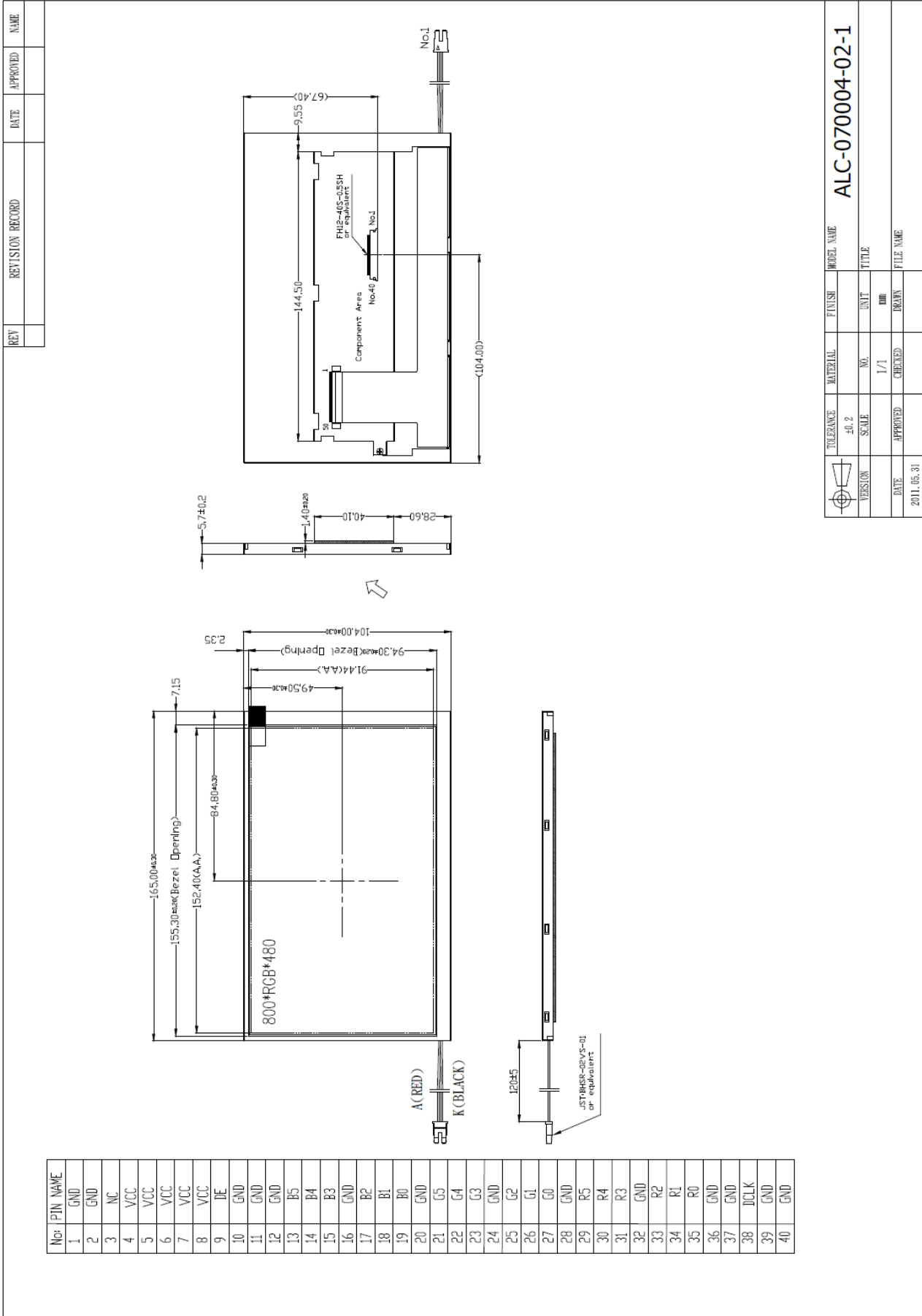
Humidity: 65±5%RH.

Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C, 240 hrs	
2	Low Temperature Operating	-20°C, 240 hrs	1
3	High Temperature Storage	80°C, 240 hrs	2
4	Low Temperature Storage	-30°C, 240 hrs	1,2
5	Damp Proof Test	60°C, 90%RH, 240 hrs	1,2
6	Temperature Shock (Non-Operating)	-30°C (1hr) ↔ 80°C (1hr), 100 Cycles	1,2
7	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
8	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  <p><i>Dropping method corner dropping:</i></p> <p><i>A corner: Once edge dropping.</i></p> <p><i>B, C, D edge: Once face dropping.</i></p> <p><i>E, F, G face: Once.</i></p>	

- 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 in a container.

7. Mechanical Drawing



8. Incoming Inspection Standards

8.1 Environment Conditions

The environmental conditions for inspection shall be as follows:

Room temperature: $23 \pm 5^{\circ}\text{C}$

Humidity: $50 \pm 20\% \text{RH}$

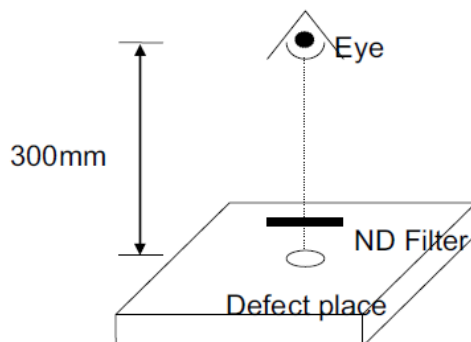
8.2 The external visual inspection

With a single 1000 ± 200 lux fluorescent lamp as the light source, the inspection was in the distance of 300mm or more from the LCD to the inspector's eyes.

8.3 Light Method

Environment lamp under 1000 ± 200 lux, viewing direction for inspection over 300mm

The distance from eyes to defect around 300mm, the distance from ND Filter to defect around 25~30mm.



8.4 Classification of Defects

8.4.1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

8.4.2 Minor defect

A minor defect refers to a defect which is not considered to be able substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

Notes: If the LCD/LCM 's cosmetic and display performance do not specify in "inspection criterion", it should be based on the delivered samples.

8.5 Sampling & Acceptable Quality Level

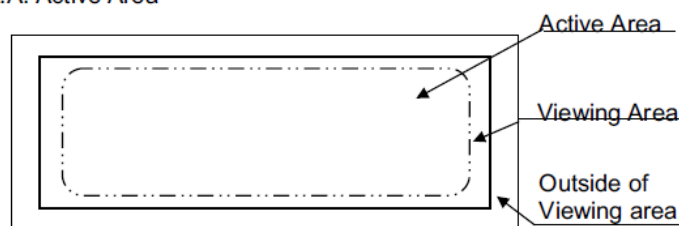
Level II, MIL-STD-105E

	Major	Minor
Cosmetic	1.0 %	1.5 %
Electrical-display	0.4%	0.65 %

8.6 Definition of Inspection Area

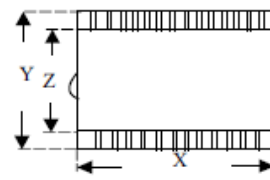
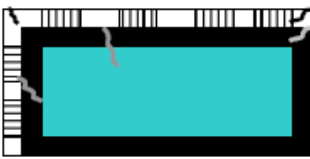
V.A: Viewing Area

A.A: Active Area

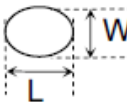
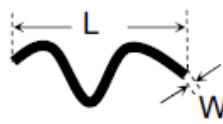

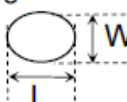


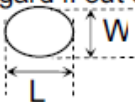
8.7 Items and Criteria
8.7.1 Visual inspection criterion in cosmetic

(1) Glass defect

No	Defect	Criteria	Remark
1	Dimension (Minor)	By engineering diagram	
2	Cracks (Major)	Extensive crack 【Reject】	

(2) LCM appearance defect

No	Defect	Criteria	Remark	
1	Round type (Minor)	Spec.	Permissible Q'ty	1. $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 
		$\phi < 0.15\text{mm}$	Disregard	
		$0.15\text{mm} \leq \phi \leq 0.50\text{mm}$	3	
2	Scratch (Minor)	Spec.	Permissible Q'ty	1.L: Length, W: Width 2. Disregard if out of A.A. 
		$W \leq 0.01\text{mm}$ and $L \leq 10\text{mm}$	Disregard	
		$0.01\text{mm} < W \leq 0.05\text{mm}$ and $L \leq 10\text{mm}$	4	
		$W > 0.05\text{mm}$ or $L > 10\text{mm}$	0	
3	Fiber (Minor)	Spec.	Permissible Q'ty	1.L: Length, W: Width 2. Disregard if out of A.A. 
		$W \leq 1.0\text{mm}$ and $L \leq 1.5\text{mm}$	4	
		$W > 1.0\text{mm}$ or $L > 1.5\text{mm}$	0	
4	Polarizer Bubble (Minor)	Spec.	Permissible Q'ty	1. $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 
		$\phi < 0.25\text{mm}$	Disregard	
		$0.25\text{mm} \leq \phi \leq 0.50\text{mm}$	2	
		$0.50\text{mm} < \phi$	0	

No	Defect	Criteria		Remark
5	Polarizer Dent (Minor)	Spec.	Permissible Q'ty	1. $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 
		$\phi < 0.25\text{mm}$	Disregard	
		$0.25\text{mm} \leq \phi \leq 0.50\text{mm}$	4	
		$0.50\text{mm} < \phi$	0	

(3) FPC

No	Defect	Criteria		Remark
1	Copper peeling (Minor)	Copper peeling	【 Reject 】	

(4) Black tape



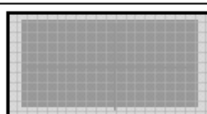
No	Defect	Criteria		Remark
1	Shift (Minor)	IC exposed	【 Reject 】	
2	No black tape (Minor)	No black tape	【 Reject 】	

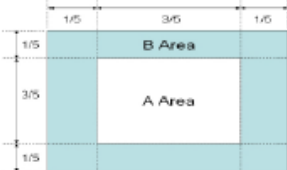
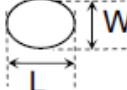
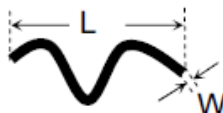
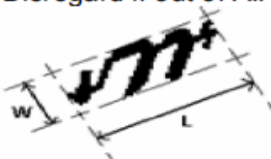
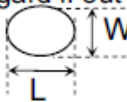
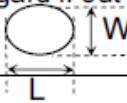
(5) Silicon

No	Defect	Criteria		Remark
1	Amount of silicon (Minor)	ITO exposed	【 Reject 】	

8.7.2 LCM electrical criterion

(1).LCM electrical criterion

No	Defect	Criteria	Remark
1	No display (Major)	Not allowed	
2	Missing line (Major)	Not allowed	
3	Darker or lighter line (Major)	Not allowed	

No	Defect	Criteria			Remark	
4	Bright / Dark point (Minor)		A Area	B Area	Total	1. sub-pixel: 1R or 1G or 1B 2. 2.Point defect area $\geq 1/2$ sub pixel. 
		Bright point	0	2	2	
		Dark dot point	2	3	3	
		Bright +Dark point	2	3	4	
		Two adjacent dot	0	1	1	
5	Round type (Minor)	Spec.	Permissible Q'ty		1. $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 	
		$\phi < 0.15\text{mm}$	Disregard			
		$0.15\text{mm} \leq \phi \leq 0.50\text{mm}$	3			
		$0.50\text{mm} < \phi$	0			
6	Scratch (Minor)	Spec.	Permissible Q'ty		1. L: Length, W: Width 2. Disregard if out of A.A. 	
		$W \leq 0.01\text{mm}$ and $L \leq 10\text{mm}$	Disregard			
		$0.01\text{mm} < W \leq 0.05\text{mm}$ and $L \leq 10\text{mm}$	4			
		$W > 0.05\text{mm}$ or $L > 10\text{mm}$	0			
7	Fiber (Minor)	Spec.	Permissible Q'ty		(2) L: Length, W: Width 2. Disregard if out of A.A. 	
		$W \leq 1.0\text{mm}$ and $L \leq 1.5\text{mm}$	4			
		$W > 1.0\text{mm}$ or $L > 1.5\text{mm}$	0			
8	Polarizer Bubble (Minor)	Spec.	Permissible Q'ty		(2) $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 	
		$\phi < 0.25\text{mm}$	Disregard			
		$0.25\text{mm} \leq \phi \leq 0.50\text{mm}$	2			
		$0.50\text{mm} < \phi$	0			
9	Polarizer Dent (Minor)	Spec.	Permissible Q'ty		(2) $\phi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 	
		$\phi < 0.25\text{mm}$	Disregard			
		$0.25\text{mm} \leq \phi \leq 0.50\text{mm}$	4			

		0.50mm ϕ	0	
No	Defect	Criteria		Remark
10	Mura (Minor)	By 6% ND filter invisible		

8.7.3 Others

8.7.3.1 Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)

8.7.3.2 Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)

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