

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH028Q27-F01 Version: 2.0

【 】 Preliminary Specification

【 ◆ 】 Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATA:

- It signifies that you fully understand and accept all the contents of this specification if you sign and send back the first page of this specifications.

Designed by	R&D Checked by	Quality Department by	Approved by
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- This specification is subject to change without notice. Please contact FORMIKE or it's representative before designing your product based on this specification.

Revision record

[illegible]

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1. General Description

1.1 Description

KWH028Q27-F01 is a Transmissive type color active matrix liquid crystal display (LCD), which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver IC, FPC and backlight unit . The following table described the features of FORMIKE KWH028Q27-F01.

1.2 Application

Mobile phone, Multimedia products
and other electronic Products
Etc.

1.3 Features:

Features	Description	UNITS
LCD type	2.8" TFT	--
Dot arrangement	240 (RGB) × 320	dots
Driver IC	ILI9341	--
Color Depth	65K	
Interface	CPU 8/16 bits	
Module size	50.9(W) × 69.2 (H) × 2.45(T)	mm
Active area	43.2(W) × 57.6(H)	mm
Dot pitch	0.18 (W) × 0.18 (H)	mm
Back Light	4 White LED In parallel	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

2. External Dimensions

[illegible]

3. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	DB0	80-system-16-Bit Data Bus.
2	DB1	80-system-16-Bit Data Bus.
3	DB2	80-system-16-Bit Data Bus.
4	DB3	80-system-16-Bit Data Bus.
5	GND	Ground
6	VCC	Power supply (+2.5V~+3.3V).
7	CS	Chip select signal, Active "L"
8	RS	Command / Display data selection 0: command; 1: display data
9	WR	Write signal input, Active" L "
10	RD	Read signal input, Active" L "
11	IM0	8080 System Interface Selection: IM0=1 8080 8-Bit system Interface. DB[8-15] IM0=0 8080 16-Bit system Interface. DB[0-15] Unused pins please connect the GND.
12	X+(XR)	Touch Panel Right Side Wire
13	Y+(YD)	Touch Panel Down Side Wire
14	X-(XL)	Touch Panel Left Side Wire
15	Y-(YU)	Touch Panel Up Side Wire
16	LED-A	Power supply for LED backlight Anode input
17	LED-K1	Power supply for LED backlight Cathode input
18	LED-K2	Power supply for LED backlight Cathode input
19	LED-K3	Power supply for LED backlight Cathode input
20	LED-K4	Power supply for LED backlight Cathode input
21	NC	NC.
22	DB4	80-system-16-Bit Data Bus.
23	DB8	80-system-16-Bit Data Bus.
24	DB9	80-system-16-Bit Data Bus.
25	DB10	80-system-16-Bit Data Bus.
26	DB11	80-system-16-Bit Data Bus.
27	DB12	80-system-16-Bit Data Bus.
28	DB13	80-system-16-Bit Data Bus.
29	DB14	80-system-16-Bit Data Bus.
30	DB15	80-system-16-Bit Data Bus.
31	RESET	Reset input pin, When reset is "L", Initialization is executed.
32	VCC	Power supply (+2.5V~+3.3V).
33	VCC	Power supply (+2.5V~+3.3V).
34	GND	Ground
35	DB5	80-system-16-Bit Data Bus.
36	DB6	80-system-16-Bit Data Bus.
37	DB7	80-system-16-Bit Data Bus.

4. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9341 is used out of the absolute maximum ratings, ILI9341 may be permanently damaged. To use ILI9341 within the following electrical characteristics limitation is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, ILI9341 will malfunction and cause poor reliability.

Item	Symbol	Unit	Value
Supply voltage	VCI	V	-0.3 ~ +4.6
Supply voltage (Logic)	VDDI	V	-0.3 ~ +4.6
Supply voltage (Digital)	VCORE	V	-0.3 ~ +2.0
Driver supply voltage	VGH-VGL	V	-0.3 ~ +32.0
Logic input voltage range	VIN	V	-0.3 ~ VDDI + 0.3
Logic output voltage range	VO	V	-0.3 ~ VDDI + 0.3
Operating temperature	Topr	°C	-40 ~ +85
Storage temperature	Tstg	°C	-55 ~ +110

Note: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5. Electrical Characteristics

Item	Symbol	Unit	Condition	Min.	Typ.	Max.	Note
Power and Operation Voltage							
Analog Operating Voltage	VCI	V	Operating voltage	2.5	2.8	3.3	Note2
Logic Operating Voltage	VDDI	V	I/O supply voltage	1.65	2.8	3.3	Note2
Digital Operating voltage	VCORE	V	Digital supply voltage	-	1.5	-	Note2
Gate Driver High Voltage	VGH	V		10.0	-	16.0	Note3
Gate Driver Low Voltage	VGL	V		-10.0	-	-5.0	Note3
Driver Supply Voltage	VGH-VGL	V		15	-	28	Note3
Current consumption during standby mode	Ist	μA	VCI=2.8V, Ta=25 °C	-	-	100	-
Input and Output							
Logic High Level Input Voltage	VIH	V	-	0.7*VDDI	-	VDDI	Note1,2,3
Logic Low Level Input Voltage	VIL	V	-	VSS	-	0.3*VDDI	Note1,2,3
Logic High Level Output Voltage	VOH	V	IOL=-1.0mA	0.8*VDDI	-	VDDI	Note1,2,3
Logic Low Level Output Voltage	VOL	V	IOL=1.0mA	VSS	-	0.2*VDDI	Note1,2,3
Logic High Level Input Current	IIH	μA	-	-	-	1	Note1,2,3
Logic Low Level input Current	IIL	μA	-	-1	-	-	Note1,2,3
Logic Input Leakage Current	ILEA	μA	VIN=VDDI or VSS	-0.1	-	+0.1	Note1,2,3

VCOM Operation							
VCOM High Voltage	VCOMH	V	Ccom=12nF	2.5	-	5.0	Note3
VCOM Low Voltage	VCOML	V	Ccom=12nF	-2.5	-	0.0	Note3
VCOM Amplitude Voltage	VCOMA	V	[VCOMH-VCOML]	4.0	-	5.5	Note3
Source Driver							
Source Output Range	Vsout	V	-	0.1	-	DDVDH-0.1	Note4
Gamma Reference Voltage	GVDD	V	-	3.0	-	5.0	Note3
Output Deviation Voltage (Source Output channel)	Vdev	mV	Sout<=4.2V	-	-	20	Note4
			Sout<=0.8V	-	-	15	-
			4.2V>Sout>0.8V	-	-	35	-
Output Offset Voltage	VOFSET	mV	-	-	-	-	Note7
Booster Operation							
1 st Booster (VCIx2) Voltage	DDVDH	V	-	4.95 (Note 5)	-	5.8 (Note 6)	Note3
1 st Booster (VCIx2) Drop Voltage	VCIx2 drop	%	loading=1 mA	-	-	5	Note3
Liner Range	Vliner	V	-	0.2	-	DDVDH-0.2	

Note 1: VDDI=1.65 to 3.3V, VCI=2.5 to 3.3V, AGND=VSS=0V. Ta= -30 to 70 (to +85 no damage) °C.

Note2: Please supply digital VDDI voltage equal or less than analog VCI voltage.

Note3: CSX, RDX, WRX, D[17:0], D/CX, RESX, TE, DOTCLK, VSYNC, HSYNC, DE, SDA, SCL, IM3, IM2, IM1, IM0, and Test pins.

Note4: When the measurements are performed with LCD module. Measurement Points are like Note3.

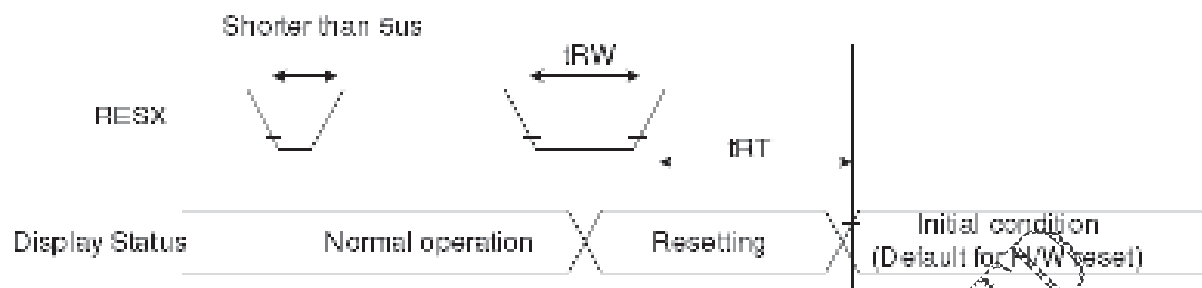
Note5: VCI=2.6V

Note6: VCI=3.3V

Note7: The Max. Value is between with Note 4 measure point and Gamma setting value

6. Timing Characteristics.

6.1 Reset Timing Characteristics.



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
				5	mS
	IRT	Reset cancel		120 (note 1,5,6,7)	mS

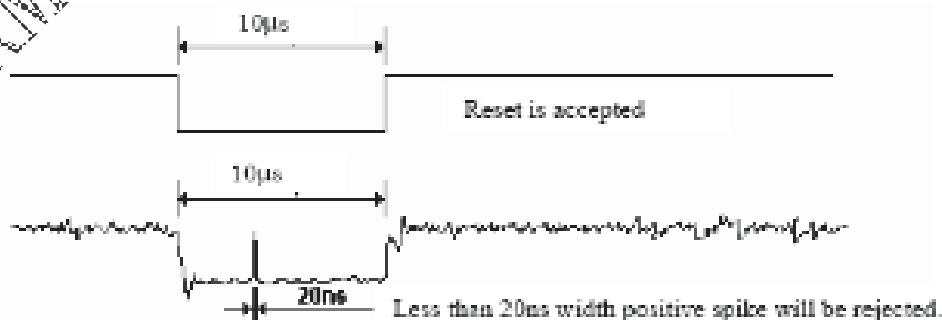
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (IRT) within 5 ms after a rising edge of RESX.

Note 2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below: -

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts

Note 3: During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms. when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) And then return to Default condition for Hardware Reset.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:

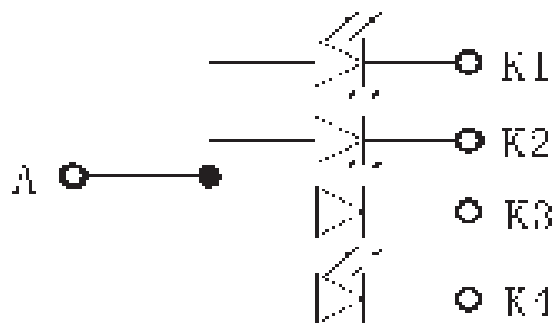


Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

7. Backlight Characteristics.



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	V_f	3.0	3.2	3.4	V	I_f=60 mA	-
Supply Current	I_f	-	60	-	mA	I_f=60 mA	-
Reverse Voltage	V_r	-	-	5	V	10uA	-
Power dissipation	P_d	-	192	-	mW	-	-
Luminous Intensity for LCM		-	320	-	Cd/m²	I_f=60 mA	-
Uniformity for LCM	-	80	-	-	%	I_f=60 mA	-
Life Time	-	50000	-	-	Hr	I_f=60 mA	-
Backlight Color	White						

8.Optical Characteristics

Item		Symbol	Conditions	Specifications	Unit	Note
Transmittance		T%	Viewing normal angle $(\theta_x = \theta_y = 0^\circ)$	6.0	%	All left side data are based on CMO's following condition - 1.CG : NTSC 60% 2.LC : TN 3.Light Source : CMI LED BLU 4.Film : Nitto Linear Polarizer 5.Machine : DMS
Contrast Ratio		CR		300	--	
Response Time (by Quick)		Ton+ Toff		30	ms	
Viewing Angle	Hor.	θ_{90}	Center CR>10	70	deg.	
		θ_{50}		70		
	Ver.	θ_{90}		70		
		θ_{50}		60		
CF only Chromaticity	Red	X_R	Viewing normal angle $(\theta_x = \theta_y = 0^\circ)$	0.635	--	Under 5 light Simulation
		Y_R		0.317	--	
	Green	X_G		0.298	--	
		Y_G		0.564	--	
	Blue	X_B		0.136	--	
		Y_B		0.116	--	
	White	X_w		0.298	--	
		Y_w		0.328	--	

*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

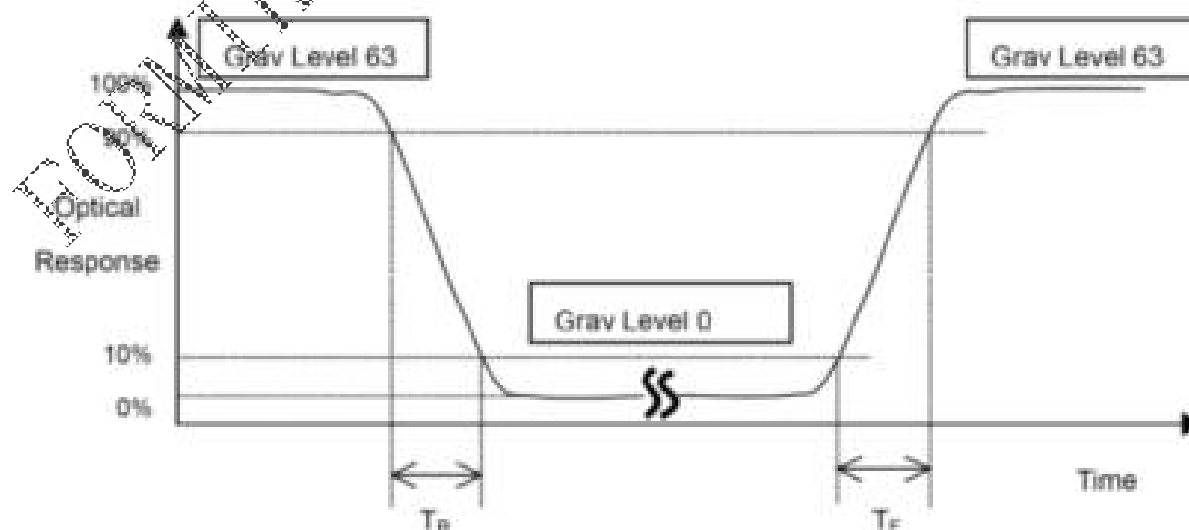
L63: Luminance of gray level 63

L0: Luminance of gray level 0

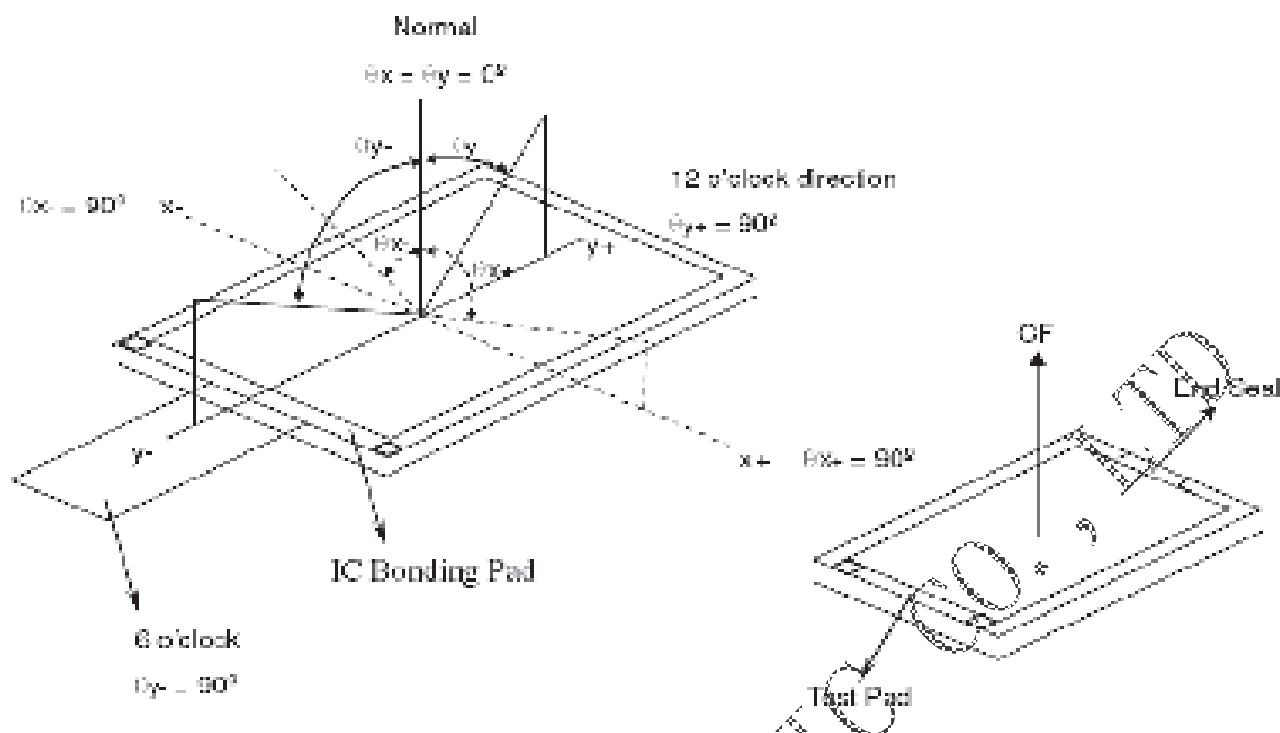
$$CR = CR(5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

*Note (2) Definition of Response Time (TR, TF):



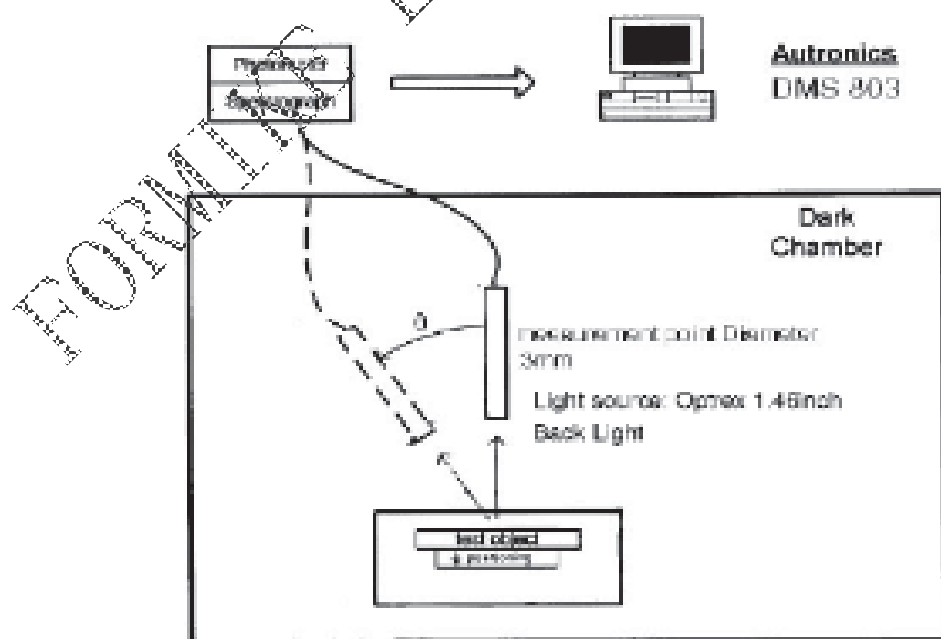
*Note(3) Definition of Viewing Angle



*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio, not for good image quality. View Direction for good image quality is 6 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a single temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



9. Reliability Test Conditions And Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	$80^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 200\text{Hours}$	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1,Air bubble in the LCD. 2,Seal leak. 3,Non-display. 4,Missing segments. 5,Glass crack. 6,Current IDD is twice higher than initial value. 7, The surface shall be free from damage. 8, The electric Characteristics requirements shall be satisfied.
②	Low Temperature Storage	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 200\text{Hours}$	
③	High Temperature Operating	$70^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 120\text{Hours}$	
④	Low Temperature Operating	$-20^{\circ}\text{C} \pm 2^{\circ}\text{C} / 120\text{Hours}$	
⑤	Temperature Cycle(Storage)	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C} \longleftrightarrow 80^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (30min) (5min) (30min) $\xleftarrow{\hspace{1.5cm}} \xrightarrow{\hspace{1.5cm}}$ 1cycle Total 10cycle	
⑥	Damp Proof Test	$50^{\circ}\text{C} \pm 5^{\circ}\text{C} \times 90\%\text{RH} \times 120\text{Hours}$	
⑦	Vibration Test	Frequency:10Hz~55Hz~10Hz Amplitude:1.5M X,Y,Z direction for total 3hours (Packing Condition)	
⑧	Drooping Test	Drop to the ground from 1M height one time every side of carton (Packing Condition)	
⑨	ESD Test	Voltage: $\pm 8\text{KV}$, R:330 Ω , C:150PF, Air Mode, 10times	

REMARK:

1,The Test samples should be applied to only one test item.

2,Sample side for each test item is 5~10pcs.

3,For Damp Proof Test,Pure water(Resistance $>10\text{M}\Omega$) should be used.

4, In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.

5,EL evaluation should be excepted from reliability test with humidity and temperature. Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.

6, Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

10. Inspection Standard

Defects are classified as major defects and minor defects according to the degree of defectiveness defined herein.

If this standard is not the same as FORMIKE <INSPECTION CRITERIA>, please refer to the FORMIKE <INSPECTION CRITERIA>.

If the customer have other agreement with FORMIKE for standard, please refer to the standard agreement.

If the defects not mentioned below or in the <INSPECTION CRITERIA> please refer to the sample.

10.1 Inspection Condition

Room Temperature: 25±5°C.

Humidity: 65±5% RH.

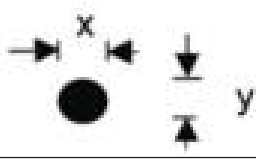
Illumination: 300 ~ 700 Lux.

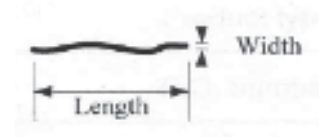
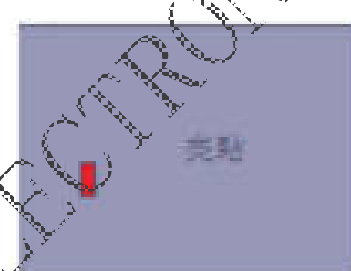
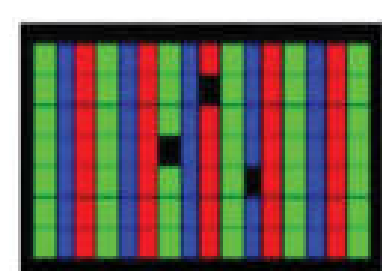
Distance: 35±5 cm

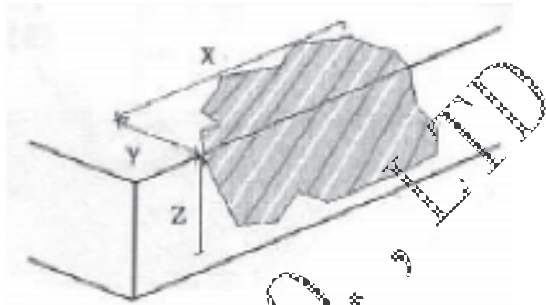
10.2 Major defect.

Item No	Items to be inspected	Inspection Standard
1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) line defect
2	missing	Missing function component
3	Crack	Glass Crack

10.3 Minor defect.

Item No	Items to be inspected	Inspection standard	
1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined:	
		$\varphi = (x+y) / 2$ 	
		Size φ (mm)	Size φ (mm)
		$\varphi \leq 0.15$	Ignore
		$0.15 < \varphi \leq 0.30$	3
		$0.30 < \varphi$	Not allowed

2	Line Defect Including Black line White line Scratch	Define:
		
		Width(mm) Length(mm)
		$W \leq 0.03$
		Acceptable Quantity
3	Polarizer Dent/Bubble	$0.03 < W \leq 0.05 \quad L \leq 4.0$
		3
		$0.03 < W \leq 0.08 \quad L \leq 4.0$
		1
		$0.08 < W \quad L > 4.0$
4	Electrical Dot Defect	Not allowed
		Width(mm) Length(mm)
		Acceptable Quantity
		$\phi \leq 0.25$
		Ignore
5	Glass defect	$0.2 < \phi \leq 0.3$
		3
		$0.3 < \phi \leq 0.5$
		1
		$0.5 < \phi$
		0
4.	Electrical Dot Defect	Bright and Black dot define:
		
		
		Inspection pattern: Full white、Full black、Red、green and blue screens
		Item
5	Glass defect	Acceptable Quantity
		I area
		O area
		Total
		Black dot defect
5	Glass defect	1
		3
		3
		Bright dot defect
		1
5	Glass defect	1
		1
		1
		Total Dot
		2
5	Glass defect	4
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5	Glass defect	1
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5	Glass defect	1
		3
		3
		1
		1
5	Glass defect	1
		3
		3
		1
		1
5	Glass defect	1
		3
		3
		1
		1
5	Glass defect	1
		3
		3
		1
		1
5	Glass defect	1
		3
		3
		1
		1
5	Glass defect	1
		3
		3
		1

		Size(mm)	Acceptable Quantity
		$X \leq 4.0\text{mm}$ $Y \leq 3.0\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width Z: thickness
		2.Side Fragment:	
			
		Size(mm)	Acceptable Quantity
		$X \leq 5.0\text{mm}$ $Y \leq 2.0\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width $Z \leq T$ Z: thickness

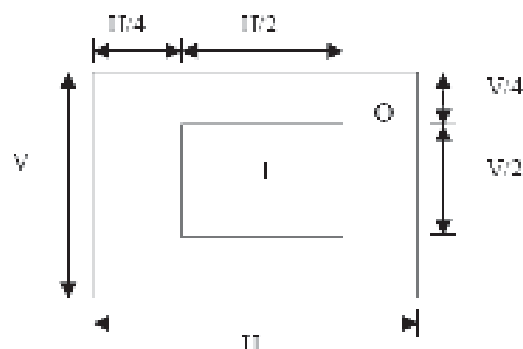
Note:

1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.
2. The distance between two bright dot defects (red, green, blue, and white) should be larger than 15mm.
3. The distance between black dot defects or black and bright dot defects should be more than 5mm apart.
4. The definitions of the inner display area

And outer display area

I: Inner display area

O: Outer display area



11. Handling Precautions

11.1 Mounting method

The LCD panel of FORMIKE ELECTRONIC CO.,LTD. module consists of two thin glass plates with polarizers which easily be damaged. And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

Extreme care should be needed when handling the LCD modules.

11.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent

[recommended below] and wipe lightly

- Isopropyl alcohol
- Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated:

- Soldering flux
- Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happens by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

11.3 Caution against static charge

The LCD module uses C-MOS LSI drivers, so we recommend that you:

Connect any unused input terminal to V_{dd} or V_{ss}, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

11.4 packing

- Module employs LCD elements and must be treated as such.
- Avoid intense shock and falls from a height.
- To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity

11.5 Caution for operation

- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life.
- An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%Rh or less is required.

11.6 storage

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.

- Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- Storing with no touch on polarizer surface by the anything else.
It is recommended to store them as they have been contained in the inner container at the time of delivery from us

11.7 Safety

- It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water

12. Precaution For Use

12.1

A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

12.2

On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- When a question is arisen in this specification
- When a new problem is arisen which is not specified in this specifications
- When an inspection specifications change or operating condition change in customer is reported to FORMIKE ELECTRONIC CO.,LTD, and some problem is arisen in this specification due to the change
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.