FORMIKE ELECTRONIC CO.,LTD

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH035ST28-F01 Version: 1.0

【 ◆ 】 Preliminary Specification

【 　 】 Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATA:

Designed by	R&D Checked by	Quality Department by	Approved by
DENG			

Prepared 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

VEV NO.	REV DATE	CONTENTS	Note
V1.0	**2012-07-11**	**NEW ISSUE**	

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1. General Description

1.1 Description

KWH035ST28-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 KWH035ST28-F01.
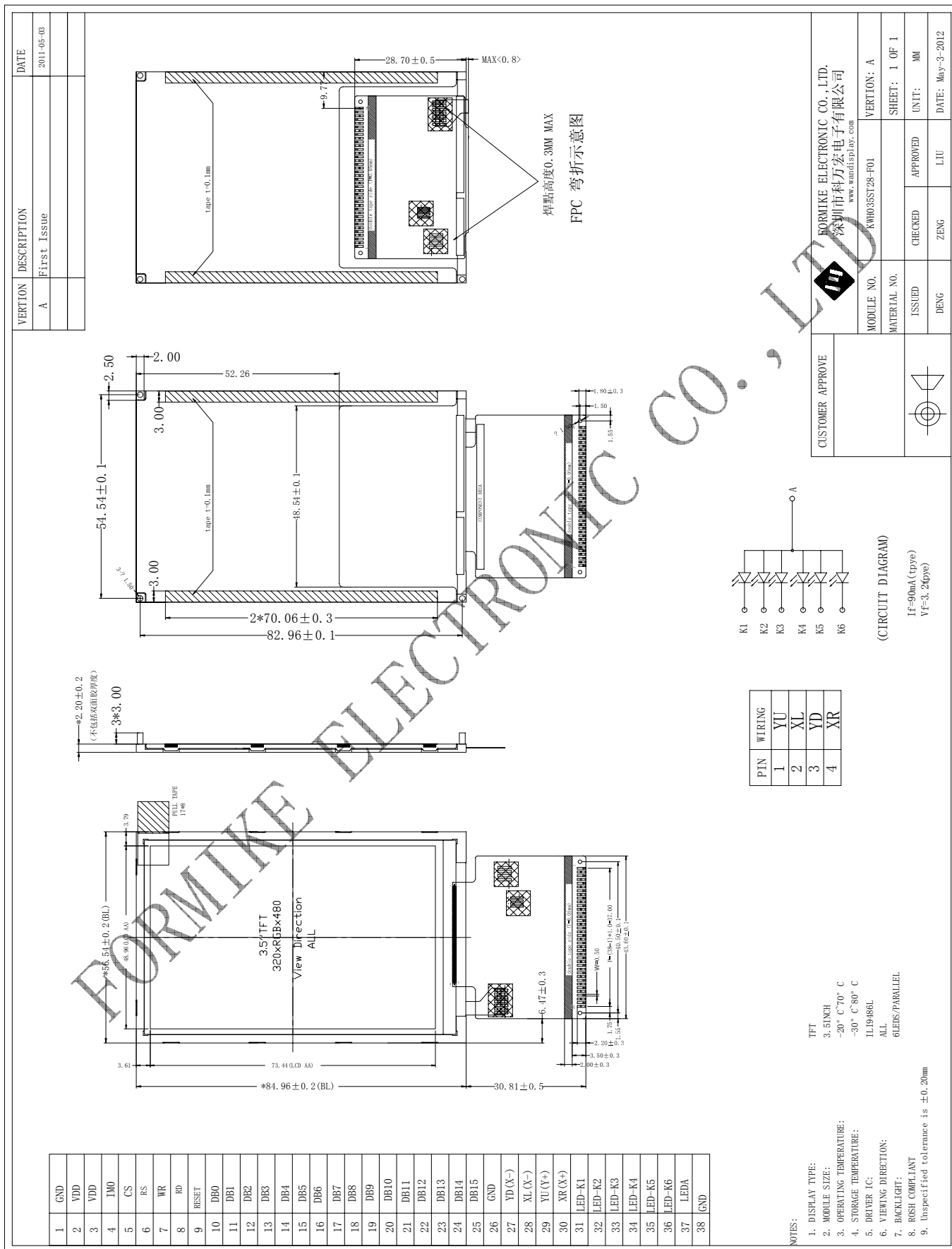
1.2   Application

Mobile phone, Multimedia products
and other electronic Products
Etc.

1.3   Features:

Features	Description	UNITS
LCD type	3.5"TFT	--
Dot arrangement	320（RGB）×480	dots
Driver IC	ILI9486L	--
Color Depth	65K	
Interface	MCU 16 or 8 bit Interface	
View Direction	ALL	
Module size	56.54(W) ×84.96 (H)×2.2(T)	mm
Active area	48.96(W) ×73.44 (H)	mm
Dot pitch	0.153 (W) ×0.153 (H)	mm
Back Light	6 White LED In parallel	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

2. External Dimensions

FORMIKE ELECTRONIC CO.,LTD

VERTION	DESCRIPTION		DATE
A	First Issue		2011-05-03

FORMIKE ELECTRONIC CO., LTD.
深圳市科万宏电子有限公司
www.wandisplay.com

MODULE NO.	KWH035ST28-F01	VERTION: A	SHEET: 1 OF 1
MATERIAL NO.			UNIT: MM
	ISSUED	CHECKED	APPROVED	DATE: May-3-2012
	DENG	ZENG	LIU

CUSTOMER APPROVE

28.70±0.5 — MAX<0.8>
9.77
tape t=0.1mm

焊點高度0.3MM MAX
FPC 弯折示意图

2.00
2.50
52.26
3.00
54.54±0.1   48.54±0.1
3.00
2*70.06±0.3
82.96±0.1
1.80±0.3
1.50
1.55

A

(CIRCUIT DIAGRAM)
K1 K2 K3 K4 K5 K6
If=90mA(tpye)
Vf=3.2(pye)

PIN	WIRING
1	YU
2	XL
3	YD
4	XR

*2.20±0.2
3*3.00

PULL TAPE
17*8

3.79

3.5"TFT
320xRGBx480
View Direction
ALL

*56.54±0.2(BL)

6.47±0.3

3.61
73.44 (LCD AA)
*84.96±0.2(BL)
30.81±0.5

NOTES:
1. DISPLAY TYPE: TFT
2. MODULE SIZE: 3.5INCH
3. OPERATING TEMPERATURE: -20° C~70° C
4. STORAGE TEMPERATURE: -30° C~80° C
5. DRIVER IC: ILI9486L
6. VIEWING DIRECTION: ALL
7. BACKLIGHT: 6LEDS/PARALLEL.
8. ROSH COMPLIANT
9. Unspecified tolerance is ±0.20mm

1	GND
2	VDD
3	VDD
4	IM0
5	CS
6	RS
7	WR
8	RD
9	RESET
10	DB0
11	DB1
12	DB2
13	DB3
14	DB4
15	DB5
16	DB6
17	DB7
18	DB8
19	DB9
20	DB10
21	DB11
22	DB12
23	DB13
24	DB14
25	DB15
26	GND
27	YD(X-)
28	XL(X-)
29	YU(Y+)
30	XR(X+)
31	LED-K1
32	LED-K2
33	LED-K3
34	LED-K4
35	LED-K5
36	LED-K6
37	LEDA
38	GND

3. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	GND	System ground.
2-3	VDD	Power supply (+2.5V-3.6V).
4	IM0	8 or 16 Bit Interface select: IM0=0 16-Bit 8080 system Interface. DB0-DB15 is used. IM0=1 8-Bit 8080 system Interface. DB0-DB7 is used.
5	CS	Chip select input pin(" low" enable).
6	RS	This pin is used to select "data or command" When RS="1", data is selected. When RS="0", command is selected.
7	WR	Write signal input, Active" L "
8	RD	Read signal input, Active" L "
9	RESET	Reset input pin, When reset is "L", Initialization is executed.
10-25	DB0-DB15	16-Bit Data Bus. Note: Please fix unused pin to ground.
26	GND	System ground.
27	YD	Touch Panel Down Side Wire.
28	XL	Touch Panel Left Side Wire.
29	YU	Touch Panel Up Side Wire.
30	XR	Touch Panel Right Side Wire.
31-36	LEDK1-K6	Power supply for LED backlight Cathode input.
37	LEDA	Power supply for LED backlight Anode input.
38	GND	System ground.

4. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9486L is used out of the absolute maximum ratings, ILI9486L may be permanently damaged. To use ILI9486L within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, ILI9486 will malfunction and cause poor reliability.

Item	Symbol	Unit	Value
Supply voltage	VCI	V	-0.3 ~ +5.0
Supply voltage (Logic)	IOVCC	V	-0.3 ~ +4.6
Supply voltage (Digital)	VCORE	V	-0.3 ~ +2.4
Driver supply voltage	VGH-VGL	V	-0.3 ~ +33.0
Logic input voltage range	VIN	V	-0.3 ~ IOVCC + 0.3
Logic output voltage range	VOUT	V	-0.3 ~ IOVCC + 0.3
Operating temperature	Topr	℃	-40 ~ +85
Storage temperature	Tstg	℃	-55 ~ +110

Notes: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	Condition	Min.	Typ.	Max.	Unit	Note
Power & Operation Voltage							
Analog operating voltage	VCI	-	2.5	2.8	3.6	V	
Logic operating voltage	IOVCC	-	1.65	2.8	3.6	V	
Digital operating voltage	VCORE	Digital block power supply	-	1.5	-	V	Note2
Gate Driver High Voltage	VGH	-	10.0	-	16.0	V	Note3
Gate Driver Low Voltage	VGL	-	-16.0	-	-9.0	V	Note3
Driver Supply Voltage	-	|VGH-VGL|	19	-	32	V	Note3
VCOM Operation							
VCOM Amplitude Voltage	VCOM	-	0	-	-2.0	V	Note3
Source Driver							
Source Output Range	Vsout	-	0.1	-	VREG1OUT-0.1	V	Note4
Positive Gamma Reference Voltage	VREG1OUT	-	3.6	-	5.5	V	Note3
Negative Gamma Reference Voltage	VREG2OUT		-5.5	-	-3.6	V	Note3
Source Output Setting Time	Tr	Below with 99% precision	-	15	20	uS	Note4,5
Output Deviation Voltage (Source Output channel)	Vdev	Sout>=4.2V Sout<=0.8V	-	-	20	mV	Note4
		4.2V>Sout>0.8V	-	-	15	mV	-
Output Offset Voltage	VOFSET	-	-	-	35	mV	Note6
Booster Operation							
1st Booster (VCI1x2) Voltage	DDVDH	-	4.5	-	6.0	V	Note3
1st Booster (VCI1x2) Voltage	DDVDL	-	-6.0	-	-4.5	V	Note3
1st Booster (VCI1x2 Drop Voltage	VCI1x2 drop	loading=1mA	-	-	5	%	Note3
Liner Range	Vliner	-	0.2	-	DDVDH-0.2	V	

Note 1: IOVCC=1.65 to 3.6V, VCI=2.5 to 3.6V, AGND=DGND=0V, Ta=-30 to 70 (to +85 no damage) ℃.

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

Note2, 3, 4: When the measurements are performed with LCD module. Measurement Points are like below.

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

Note5: Source channel loading = 10pF/channel, Gate channel loading = 50pF/channel

Note6: The Max. Value is between with Note 4 measure point and Gamma setting value

6.Timing Characteristics.

6.1 Reset Timing Characteristics.
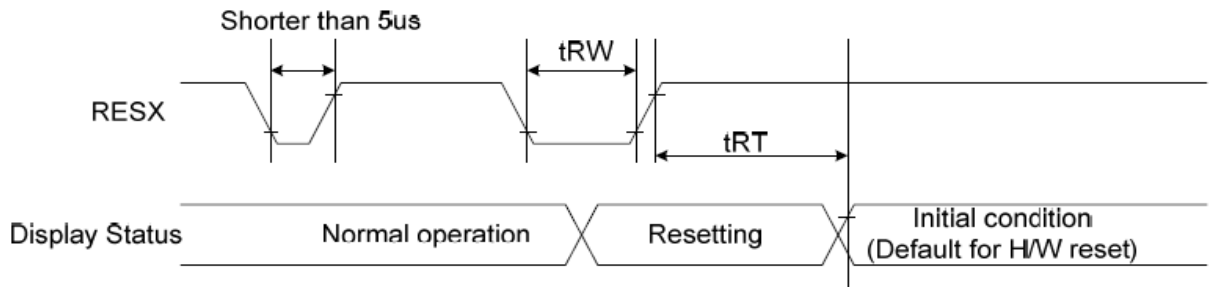
| Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time (tRT) 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 9us	Reset
Between 5us and 9us	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:
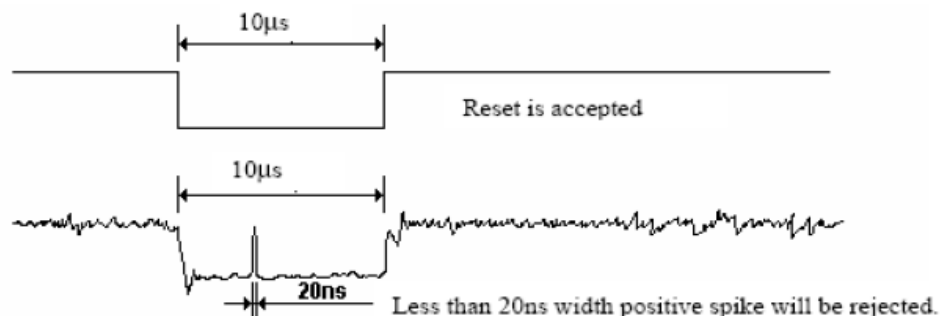
Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

Note7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

## 6.2. i80-System Interface Timing Characteristics.
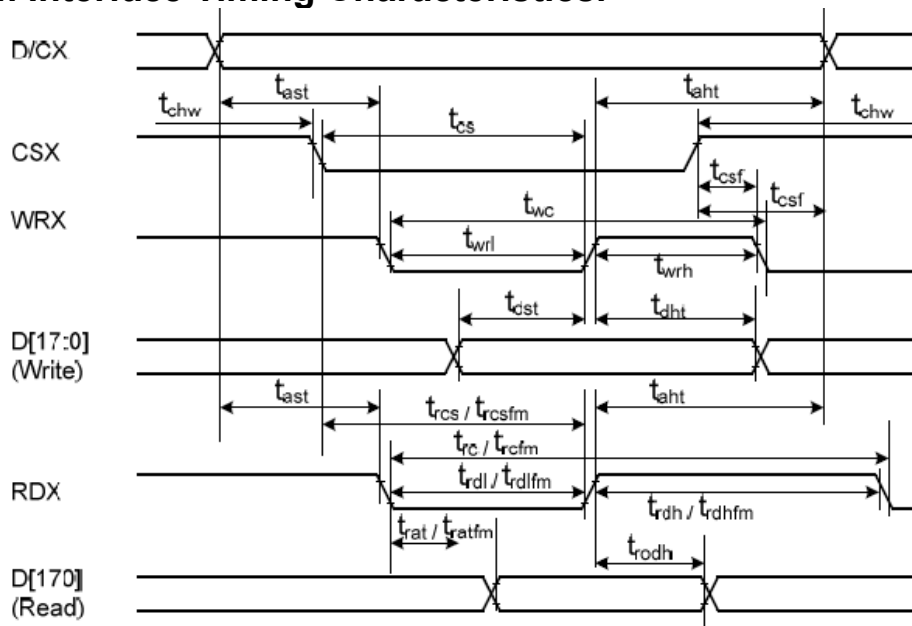
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	-
	taht	Address hold time (Write/Read)	0	-	ns	-
CSX	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	15	-	ns	-
	trcs	Chip Select setup time (Read ID)	45	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	-
	tcsf	Chip Select Wait time (Write/Read)	0	-	ns	-
WRX	twc	Write cycle	50	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
	twrl	Write Control pulse L duration	15	-	ns	-
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	When read ID data
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[17:0], DB[15:0], DB[8:0] DB[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: (1) Ta = -30 to 70 ℃, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, AGND=DGND=0V
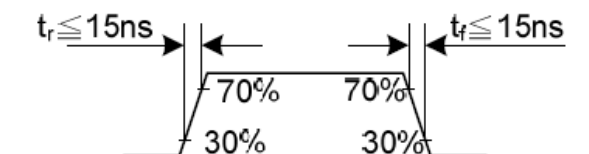
7. Backlight Characteristics.
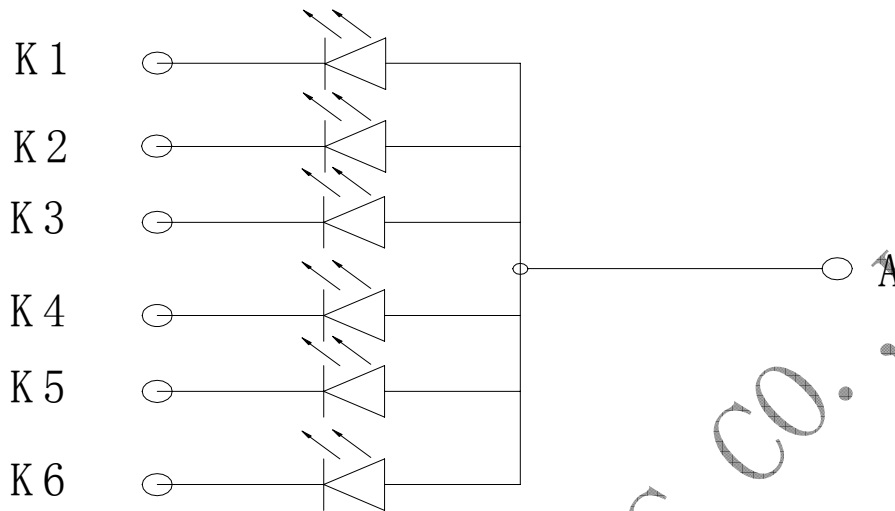
Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	**Vf**	**3.0**	**3.2**	**3.4**	**V**	**If=90 mA**	**-**
Supply Current	**If**	**-**	**90**	**-**	**mA**	**-**	**-**
Reverse Voltage	**Vr**	**-**	**-**	**5**	**V**	**10uA**	
Power dissipation	**Pd**	**-**	**282**	**-**	**mW**	**-**	
Luminous Intensity for L CM		**200**	**220**	**260**	**Cd/m^2**	**If=90 mA**	
Uniformity for LCM		**-**	**80**	**-**	**-**	**%**	**If=90 mA**	
Life Time		**-**	**50000**	**-**	**-**	**Hr**	**If=90 mA**	**-**
Backlight Color		**White**					

8.Optical Characteristics

Item		Symbol	Conditions	Specifications (typ)	Unit	Note
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$	4.0	%	All left side data are based on CMI's following condition – 1.CG : NTSC 70% 2.AR : 67.5% 3.Light Source : CMI LED BLU 4.Machine : DMS 803 5. Vwhite > 5.0 V, Vdark < 0.4V 6. Polarizer : NPF-TEGQ1465DUHC
Contrast Ratio		CR		700	--	
Response Time		Ton+ Toff		30	ms	
Viewing Angle	Hor.	θ_{X+}	Center CR>10	80	deg.	
		θ_{X-}		80		
	Ver.	θ_{Y+}		80		
		θ_{Y-}		80		
CF only Chromaticity	Red	X_R	Viewing normal angle $\theta_X = \theta_Y = 0°$	0.654	--	Under C light Simulation
		Y_R		0.326	--	
	Green	X_G		0.271	--	
		Y_G		0.586	--	
	Blue	X_B		0.150	--	
		Y_B		0.083	--	
	White	X_W		0.306	--	
		Y_W		0.318	--	

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

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

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):
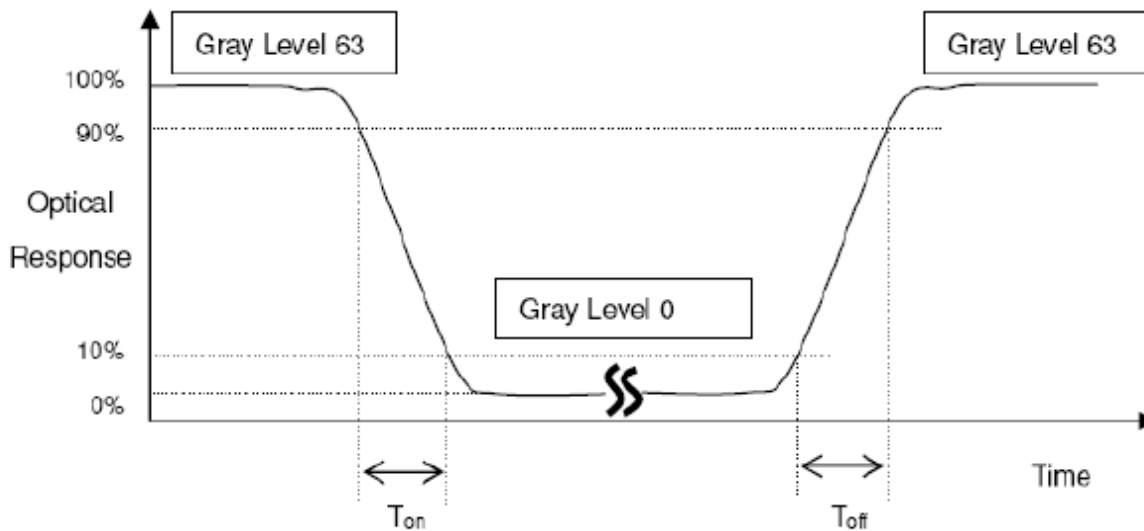
*Note(3) Definition of Viewing Angle
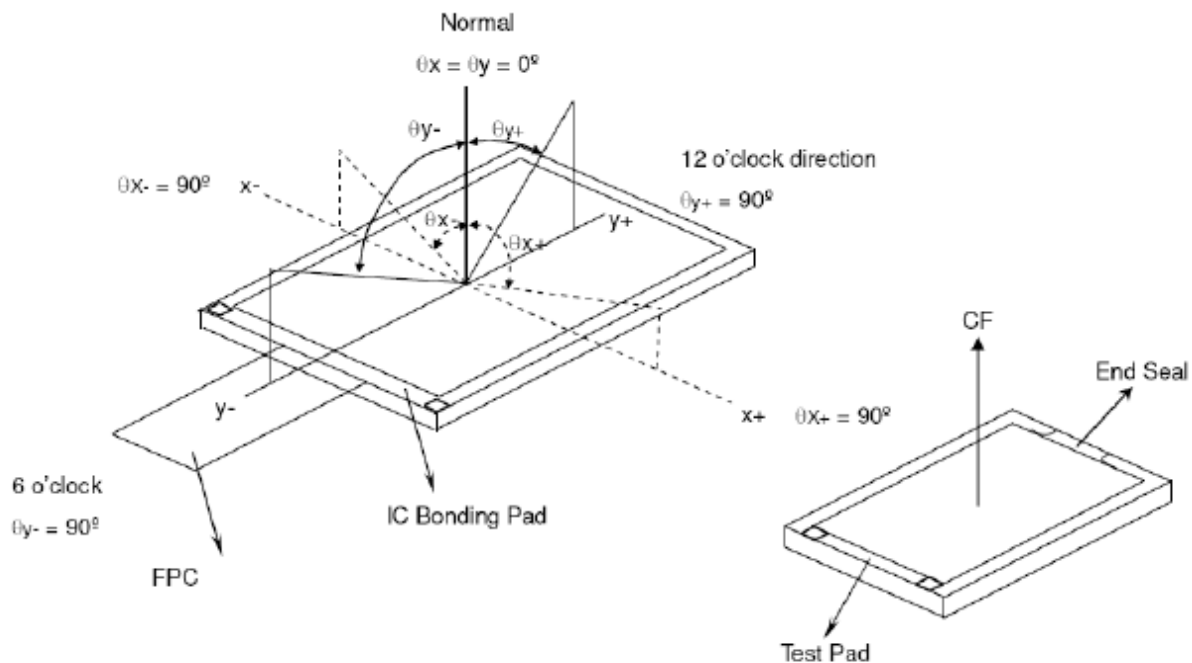
*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is Free. Module maker can increase the "Viewing Angle" by applying Wide View Film.

*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given 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.

Autronics
DMS 803

Dark Chamber

θ

measurement point Diameter :3mm

test object
φ positioning

*Note (5)

Horizontal dimension

Vertical dimension

: test point

X=1 to 5

Active area
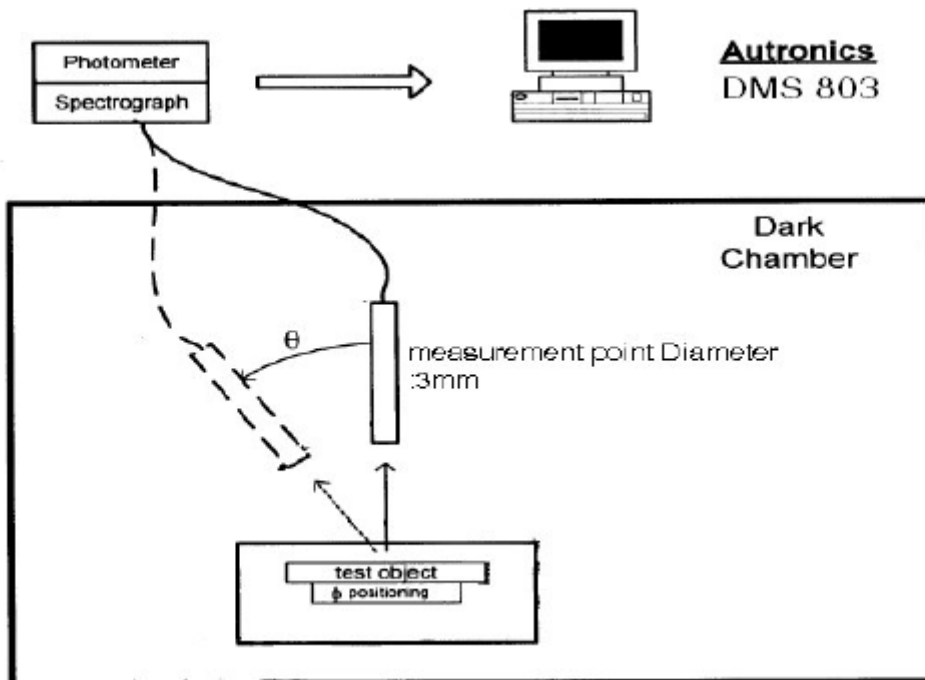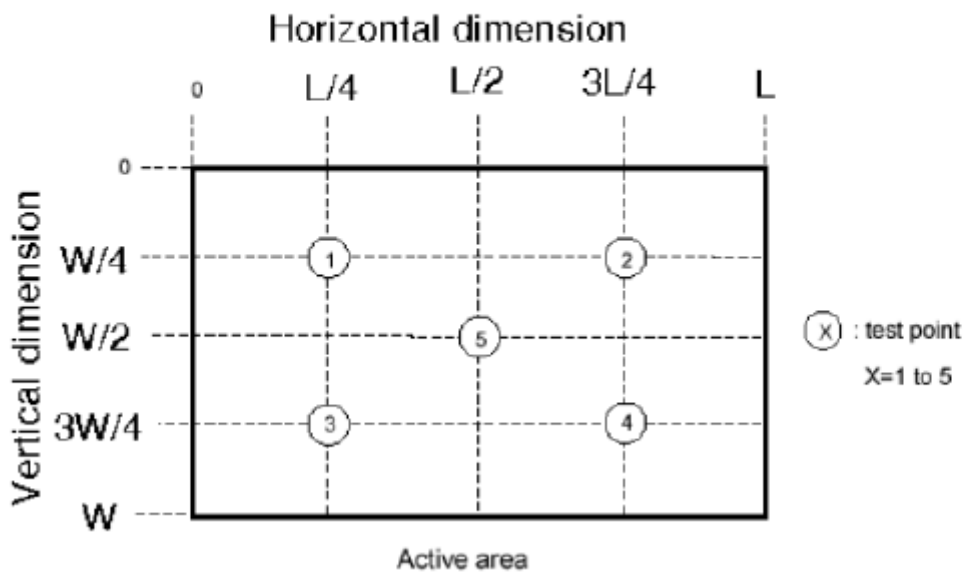
9. Reliability Test Conditions And Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	80℃±2℃×200Hours	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1,Air bubble in the LCD. 2,Sealleak. 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℃±2℃×200Hours	
③	High Temperature Operating	70℃±2℃×120Hours	
④	Low Temperature Operating	-20℃±2℃/120Hours	
⑤	Temperature Cycle(Storage)	-30℃±2℃ ⟺ 25℃ 80℃±2℃ (30min) (5min) (30min) 1cycle Total 10cycle	
⑥	Damp Proof Test	50℃±5℃×90%RH×120Hours	
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: ±8KV,R:330Ω,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＞10MΩ)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

This standard apply to TFT module specification.

1. Inspection condition：

Under daylight lamp 20～40W，product distance inspector'eye 30cm,incline degree 30°。

30 degree
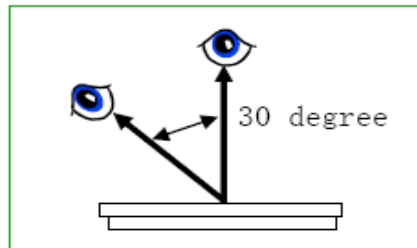
2. Inspection standard

NO.	Item	Inspection standard	Rate
2.1	Dot	Case of Dot defect is below ① Bright Dot (whit spot) : "0" ② Dark Dot (black spot) : "0" (In case of Dark Dot on Main TFT LCD) - NG if there's full Dot defect. - Damaged less than the size of sub-pixel is not counted as defect - Dots darker than the size of sub-pixel are not defined as bright dot defect **area size（mm） / Acceptable number** Φ≤0.10 : ignore 0.10＜Φ≤0.15 : 3 0.15＜Φ≤0.20 : 2 0.25＜Φ≤0.25 : 1 0.25＜Φ : 0	minor
2.2	line		

2.1 Dot (area size table)

area size（mm）	Acceptable number
Φ≤0.10	ignore
0.10＜Φ≤0.15	3
0.15＜Φ≤0.20	2
0.25＜Φ≤0.25	1
0.25＜Φ	0

2.2 line

Size（mm）		Acceptable number
ignore	W≤0.03	ignore
L≤4.0	0.03＜W≤0.04	2
L≤4.0	0.04＜W≤0.05	1
	0.05＜W	Treat with dot non-conformance

11. Handling Precautions

11.1 Mounting method

The LCD panel of FORMIKE ELECTRONIC CO,.LTD. module consists of two thin glass plates with polarizes which easily be damaged. And since the module in 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) , Salfur (S)

If goods were sent without being sili8con coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

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

11.3 Caution against static charge

The LCD module use C-MOS LSI drivers, so we recommended that you:

Connect any unused input terminal to Vdd or Vss, 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 employ 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 then the limit cause 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 then the operating temperature range and on the other hand at higher temperature LCD's how 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.