

## PRODUCT SPECIFICATION

### TFT LCD MODULE

**MODEL : KWH014ST02-F01** Version: 1.0

- Preliminary Specification  
 Finally Specification

FORMIKE ELECTRONIC CO., LTD

<b>CUSTOMER'S APPROVAL</b>	
<b>SIGNATURE:</b>	<b>DATA:</b>

<b>Designed by</b>	<b>R&amp;D Checked by</b>	<b>Quality Department by</b>	<b>Approved by</b>
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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.**



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## 1. General Description

### 1.1 Description

KWH014ST02-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 KWH014ST02-F01.

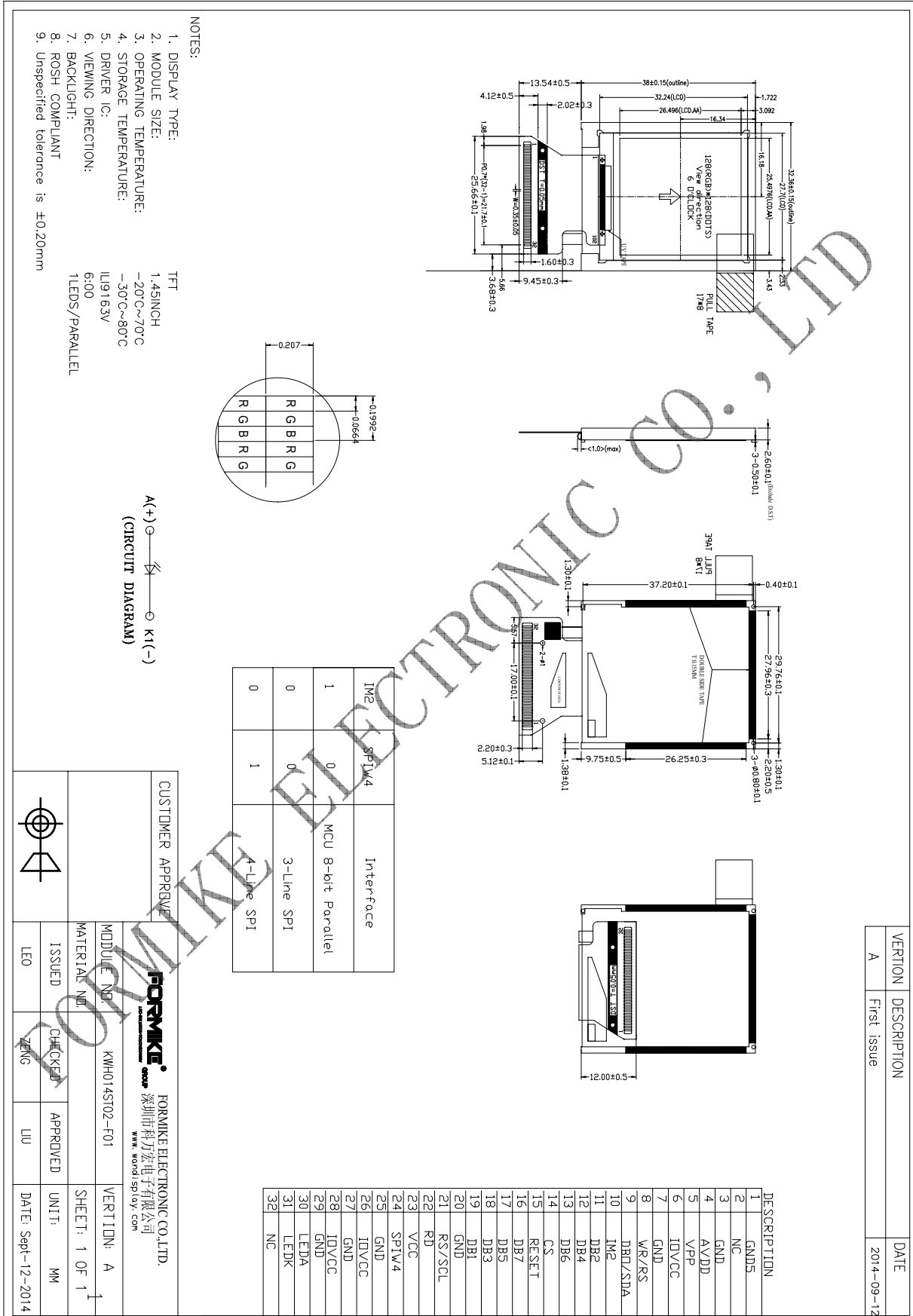
### 1.2 Application

Mobile phone, Multimedia products  
and other electronic Products  
Etc.

### 1.3 Features:

Features	Description	UNITS
LCD type	1.44" TFT	--
Dot arrangement	128 (RGB) × 128	dots
Driver IC	ILI9163V	--
Color Depth	65K	
Interface	CPU 8 bits/SPI	
Module size	32.36(W) × 38.00 (H) × 2.60(T)	mm
Active area	25.4976(W) × 26.496(H)	mm
Dot pitch	0.1992 (W) × 0.207 (H)	mm
Back Light	1 White LED	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

## 2. External Dimensions



### 3. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	GND5	Ground.
2	NC	No Connection
3	GND	Ground.
4	AVDD	A power output pin for source driver block that is generated from power block. Connect a capacitor for stabilization.
5	VPP	Power supply When programming NVM, if not use, please let this pin open
6	IOVCC	Power supply for interface logic circuits
7	GND	Ground.
8	WR/RS	Write enable in parallel interface WR: for 8080 MCU RS: for 4-wire SPI If not use, please connect to GND or IOVCC.
9	DB0/SDA	MCU Data Bus for D0/ SDA in SPI interface mode.
10	IM2	MCU Parallel interface bus and Serial interface select IM2='1'; Parallel Interface IM2='0'; Serial Interface
11	DB2	MCU Data Bus for DB2.
12	DB4	MCU Data Bus for DB4.
13	DB6	MCU Data Bus for DB6.
14	CS	Chip select input pin ( "Low" enable).
15	RESET	Chip reset pin ( "Low Active" ).
16	DB7	MCU Data Bus for DB7.
17	DB5	MCU Data Bus for DB5.
18	DB3	MCU Data Bus for DB3.
19	DB1	MCU Data Bus for DB1.
20	GND	Ground.
21	RS/SCL	Display data/Command selection pin in parallel and SCL in 3-pin SPI interface. If not used, please connect this pin to GND.
22	RD	Read enable in 8080-parallel interface
23	VCC	Power supply for analog circuit.
24	SPIW4	SPI interface selection pin SPI4W=' 0' : 3-wire SPI. (default) SPI4W=' 1' : 4-wire SPI.
25	GND	Ground.
26	IOVCC	Power supply for interface logic circuits
27	GND	Ground.
28	IOVCC	Power supply for interface logic circuits
29	GND	Ground.
30	LEDA	Power supply for LED backlight Anode input.
31	LEDK	Power supply for LED backlight Cathode input.
32	NC	No Connection

## 4. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9163V is used out of the absolute maximum ratings, the ILI9163V may be permanently damaged. To use the ILI9163V within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the ILI9163V will malfunction and cause poor reliability.

Item	Symbol	Unit	Value Note
Supply voltage	VCI	V	-0.3 ~ +4.0
Supply voltage (Logic)	VDDI	V	-0.3 ~ +3.3
Supply voltage (Digital)	VCC	V	-0.3 ~ +2.0
Driver supply voltage	VGH-VGL	V	-0.3 ~ +33.0
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

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	Unit	Condition	Min.	Typ.	Max.	Note
<b>Power &amp; Operation Voltage</b>							
Analog Operating voltage	VCI	V	Operating voltage	2.5	2.78	4.0	Note2
Logic Operating voltage	VDDI	V	I/O supply voltage	1.65	1.8/2.78	3.3	Note2
Digital Operating voltage	VCC	V	Digital supply voltage		1.8		Note2
Gate Driver High voltage	VGH	V		10.0		16.0	Note3
Gate Driver Low voltage	VGL	V		-16.0		-7.5	Note3
Driver Supply voltage		V	VGH-VGL	19		32	Note3
<b>Input/Output</b>							
Logic High level input voltage	VIH	V		0.7VDDI		VDDI	Note1,2,3
Logic Low level input voltage	VIL	V		VSS		0.3VDDI	Note1,2,3
Logic High level output voltage	VOH	V	IOH = -1.0mA	0.8VDDI		VDDI	Note1,2,3
Logic High level output voltage	VOL	V	IOL = 1.0mA	VSS		0.2VDDI	Note1,2,3
Logic input leakage current	IIL	μA	VIN = VDDI or VSS	-0.1		+0.1	Note1,2,3
Sleep in current consumption	ISLP	μA	VCI=VDDI=2.8V Ta=25 °C			70	Note1,2,3
<b>VCOM Operation</b>							

VCOM High voltage	VCOMH	V	Ccom=12nF	2.5		5.0	Note 3
VCOM Low voltage	VCOML	V	Ccom=12nF	-2.5		0.0	Note 3
VCOM Amplitude voltage	VOMA	V	VCOMH-VCOML	4.0		5.5	Note 3
<b>Source Driver</b>							
Source output range	Vsout	V		0.1		AVDD-0.1	Note4
Gamma reference voltage	GVDD	V		3.0		5.0	Note3

Note 1: VDDI=1.65 to 3.3V, VCI=2.5 to 4.0V, AGND=GND=0V, Ta=-30 to 70°C (to +85°C no damage)

Note2: Please supply digital VDDI voltage equal or less than analog VCI voltage. ( $VDDI \leq VCI$ )

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

Note3: CSX, RDX, WRX, D[23:0], D/CX, RESX, TE, PCLK, VS, HS, DE, SDA, SCL, GM2, GM1, GM0, RCM1, RCM0, P68, IM2, IM1, IM0, SRGB, REV, SMX, SMY, RL, TB, IDM, SHUT, PREG, GS and Test pins.

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

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## 6. Timing Characteristics.

### 6.1 Reset Timing Characteristics.

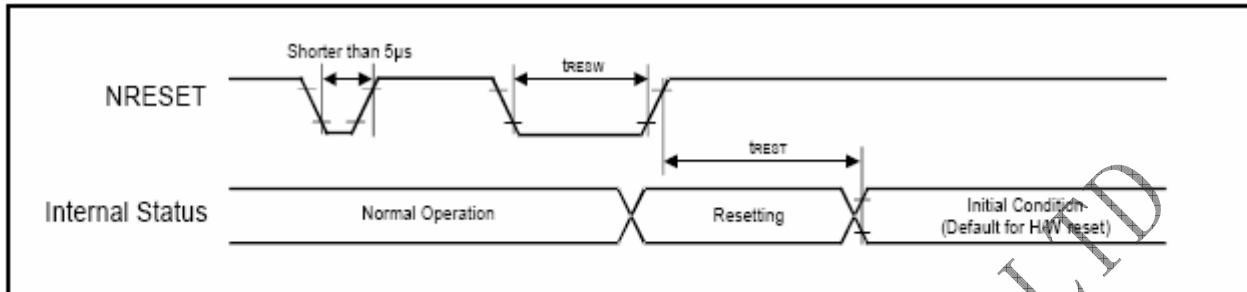


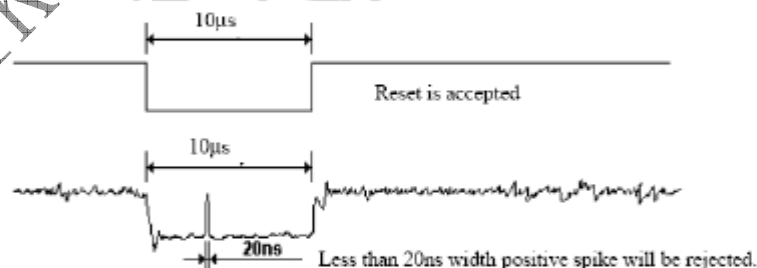
Figure 11. 6 Reset Input Timing

Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
tRESW	Reset low pulse width <sup>(1)</sup>	NRESET	10	-	-	-	µs
tREST	Reset complete time <sup>(2)</sup>	-	-	-	5	When reset applied during Sleep In mode	ms
		-	-	-	120	When reset applied during Sleep Out mode	ms

Note: (1) Spike due to an electrostatic discharge on !RES line does not cause irregular system reset according to the following table.

NRESET Pulse	Action
Shorter than 5µs	Reset Rejected
Longer than 10µs	Reset
Between 5µs and 10µs	Reset Start

- (2) 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 H/W reset.
- (3) During Reset Complete Time, ID2 and VCOMOF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of RESET.
- (4) Spike Rejection also applies during a valid reset pulse as shown as below:



- (5) It is necessary to wait 5msec after releasing RESET before sending commands. Also Sleep Out command cannot be sent for 120ms.

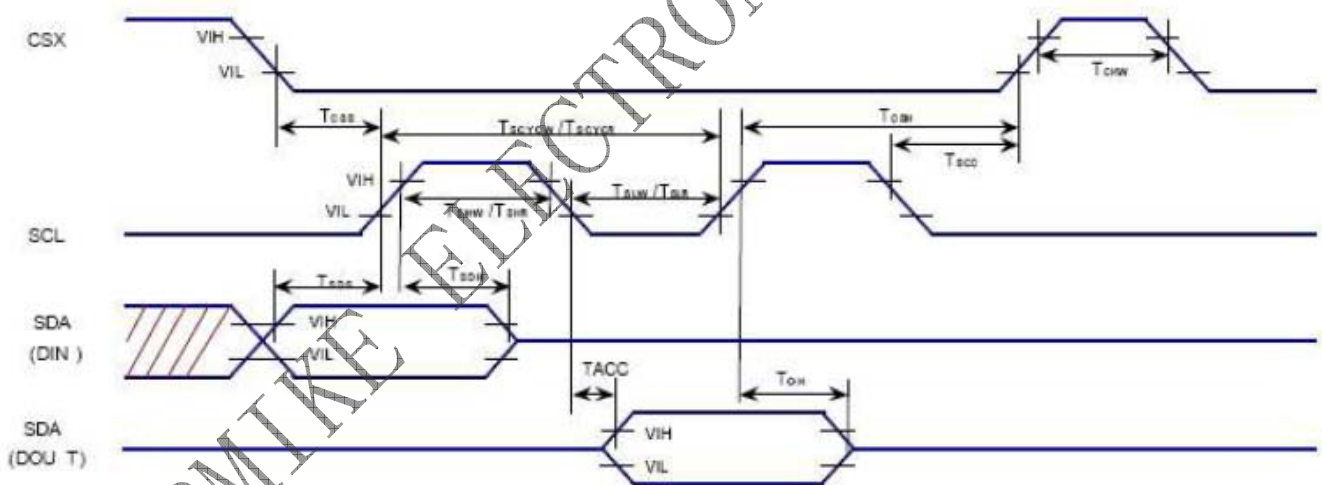


	trdh	Control pulse H duration(ID)	90		ns	data
	trdl	Control pulse L duration(ID)	45		ns	
RDX	trcfm	Read cycle (FM)	450		ns	When read from frame memory
	trdhfm	Control pulse H duration (FM)	90		ns	
	trdlfm	Control pulse L duration (FM)	355		ns	
D[17..0]	tdst	Data setup time	10		ns	For maximum CL = 30pF For minimum CL = 8pF
	tdht	Data hold time	10		ns	
	trat	Read access time (ID)		40	ns	
	tratfm	Read access time (FM)		340	ns	
	todh	Output disable time	20	80	ns	

Note 1: VDDI 1.65 to 3.3V, VPNL=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70 °C (to +85°C no damage)

Note 2: This input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals

### 6.3 3-pin Serial Interface Timing Characteristics.



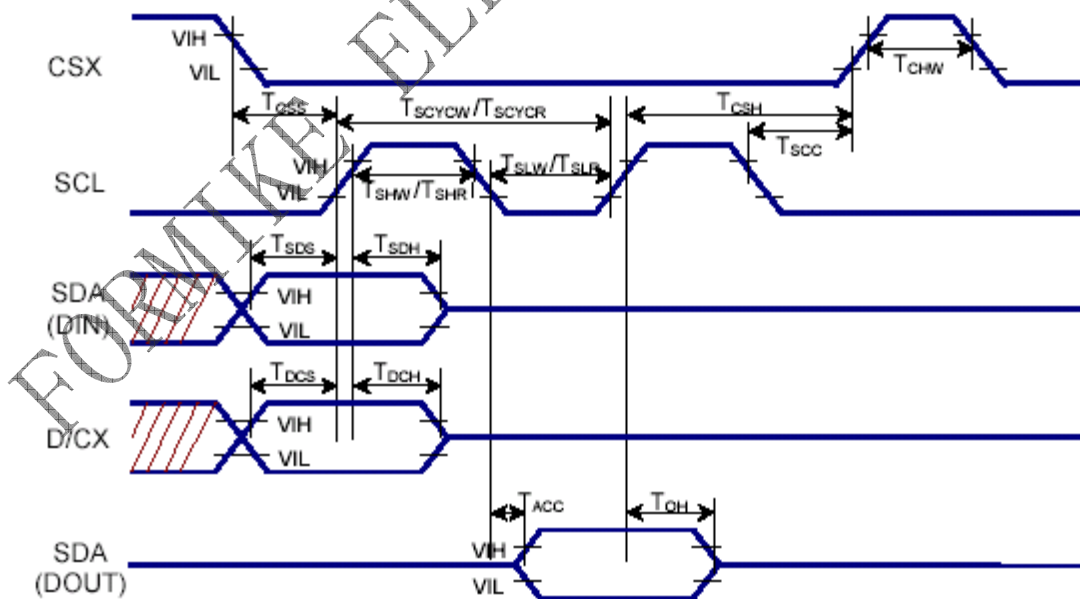
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L""H" pulse width(Write)	15		ns	
	TSLW	S"L""L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L""H" pulse width(Read)	60		ns	
	TSLR	S"L""L" pulse width(Read)	60		ns	
SDA(DIN) (DOUT)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70°C (to +85°C no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

#### 6.4 4-pin Serial Interface Timing Characteristics.



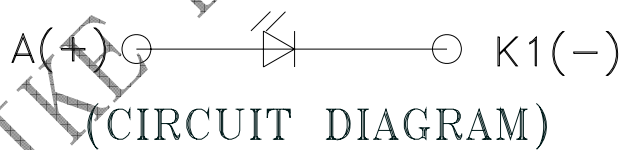
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L"H" pulse width(Write)	15		ns	
	TSLW	S"L"L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L"H" pulse width(Read)	60		ns	
	TSLR	S"L"L" pulse width(Read)	60		ns	
D/CX	TDCS	D/CX setup time	5		ns	
	TDCH	D/CX hold time	5		ns	
SDA(DIN) (DOUT)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70°C (to +85°C no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

## 7. Backlight Characteristics



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	<b>Vf</b>	<b>3.0</b>	<b>3.2</b>	<b>3.4</b>	<b>V</b>	<b>If=15 mA</b>	-
Supply Current	<b>If</b>	-	<b>15</b>	-	<b>mA</b>	-	-
Reverse Voltage	<b>Vr</b>	-	-	<b>5</b>	<b>V</b>	<b>10uA</b>	
Power dissipation	<b>Pd</b>	-	<b>48</b>	-	<b>mW</b>	-	
Luminous Intensity for LCM		<b>120</b>	<b>140</b>	-	<b>Cd/m2</b>	<b>If=15 mA</b>	
Uniformity for LCM	-	<b>80</b>	-	-	<b>%</b>	<b>If=15 mA</b>	
Life Time	-	<b>50000</b>	-	-	<b>Hr</b>	<b>If=15 mA</b>	-
Backlight Color		<b>White</b>					

## 8.Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)	T(%)	—	—	17.5	—	—	
Contrast Ratio	CR	$\Theta=0$ Normal viewing angle	400	500	—	—	(1)(2) Measuring with EWV Polarizer · Reference Only
Response time	Rising	$T_R$	—	4	8	msec	(1)(3)
	Falling	$T_F$	—	12	24		
Color gamut	S(%)			53		%	
Color chromaticity (CIE1931)	White	$W_x$	0.273	0.293	0.313		(1)(4) CF glass
		$W_y$	0.305	0.325	0.345		
	Red	$R_x$	0.616	0.636	0.656		
		$R_y$	0.308	0.328	0.348		
	Green	$G_x$	0.263	0.283	0.303		
		$G_y$	0.511	0.531	0.551		
	Blue	$B_x$	0.115	0.135	0.155		
		$B_y$	0.114	0.134	0.154		
Viewing angle	Hor.	$\Theta_L$	60	70	—		Measuring with EWV Polarizer · Reference Only
		$\Theta_R$	60	70	—		
	Ver.	$\Theta_U$	60	70	—		
		$\Theta_D$	50	60	—		
Optima View Direction			12 O'clock				(5)

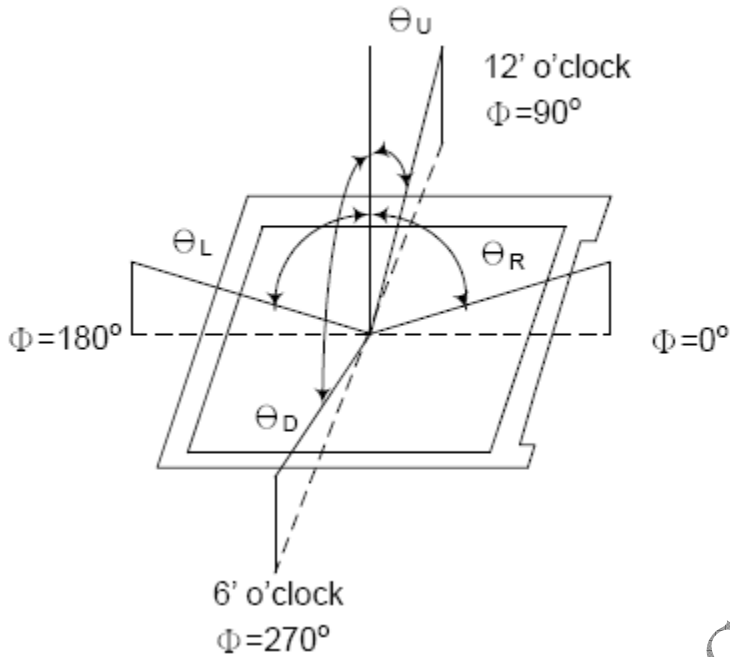
### Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : 25±2°C
- 15min. warm-up time.

### Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

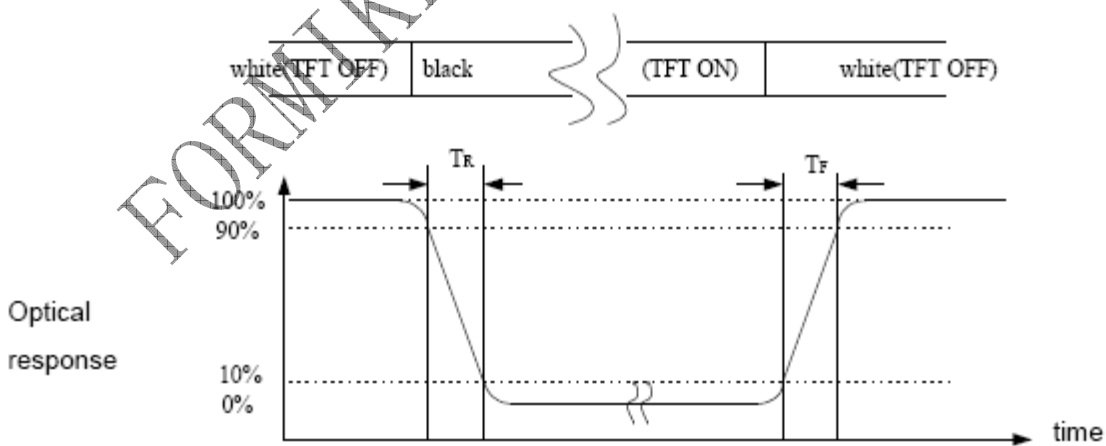
**Note (1)** Definition of Viewing Angle :



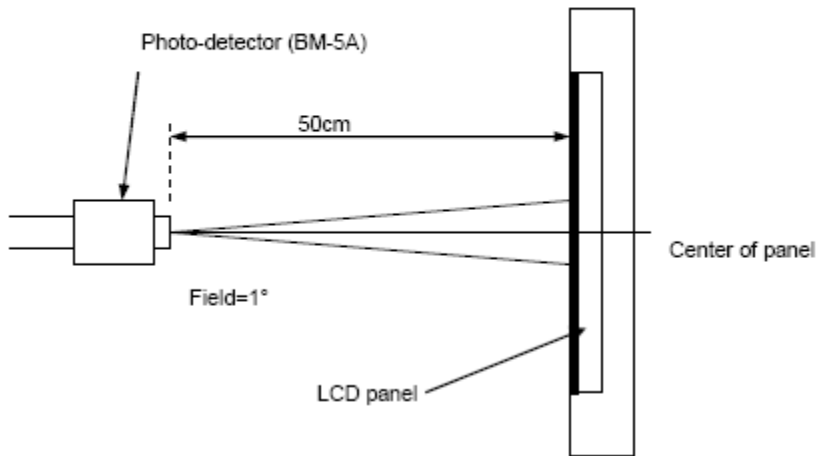
**Note (2)** Definition of Contrast Ratio(CR) :  
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

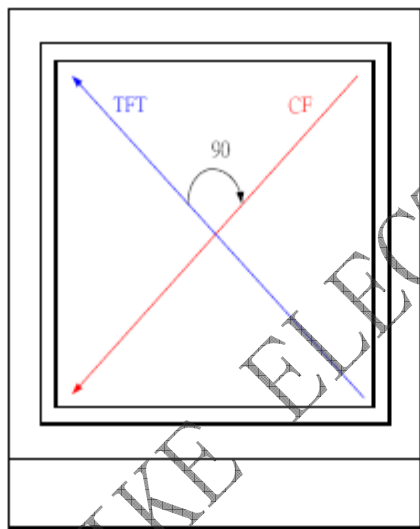
**Note (3)** Definition of Response Time: Sum of  $T_R$  and  $T_F$



**Note (4)** Definition of optical measurement setup



**Note (5)** Rubbing Direction (The different Rubbing Direction will cause the different view direction.)



TFT Face up



## 9. Reliability Test Conditions And Methods

N O.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	80°C ± 2°C × 240Hours	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°C ± 2°C × 240Hours	
③	High Temperature Operation	70°C ± 2°C × 240Hours	
④	Low Temperature Operation	- 20°C ± 2°C / 240Hours	
⑤	Thermal Shock (Non-Operation)	- 20°C ± 2°C ↔ 25°C ↔ 70°C ± 2°C (30min) (5min) (30min) ←————— 1cycle —————→ Total 10cycle	
⑥	High Temperature and High Humidity Storage	40°C ± 5°C × 90%RH × 240Hours	
⑦	Electro Static Discharge (Operation)	C=150pF,R=330Ω, points/panel Air: ± 8KV,5 times Contact: ± 4KV,5 times (Environment:15°C~35°C 30%~60%,86Kpa~106Kpa)	
⑧	Vibration (Non-Operation)	Frequency:10Hz~55Hz~10Hz Amplitude:1.5M X,Y,Z direction for total 3hours (Packing Condition)	
⑨	Package Drop Test	Height:80cm 1 corner,3 edges,6 surfaces.	

**REMARK:**

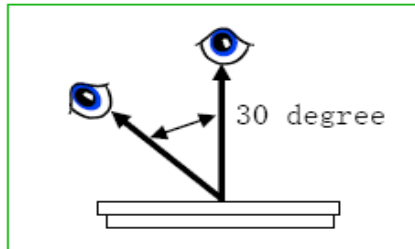
- 1,The Test samples should be applied to only one test item.
- 2,Sample side for each test item is 5~10pcs.
- 3,For Damp Proof Test,Pure water(Resistance>10MΩ) should be used.
- 4, In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would 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°.



### 2. Inspection standard

NO.	Item	Inspection standard	Rate														
2.1	Dot	<p>Case of Dot defect is below</p> <p>① Bright Dot (whit spot) : "0"</p> <p>② Dark Dot (black spot) : "0" (In case of Dark Dot on Main TFT LCD)</p> <p>- NG if there's full Dot defect.</p> <p>- Damaged less than the size of sub-pixel is not counted as defect</p> <p>- Dots darker than the size of sub-pixel are not defined as bright dot defect</p>	minor														
		<table border="1"> <thead> <tr> <th>area size (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.10</math></td> <td>ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.15</math></td> <td>3</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.20</math></td> <td>2</td> </tr> <tr> <td><math>0.25 &lt; \Phi \leq 0.25</math></td> <td>1</td> </tr> <tr> <td><math>0.25 &lt; \Phi</math></td> <td>0</td> </tr> </tbody> </table>		area size (mm)	Acceptable number	$\Phi \leq 0.10$	ignore	$0.10 < \Phi \leq 0.15$	3	$0.15 < \Phi \leq 0.20$	2	$0.25 < \Phi \leq 0.25$	1	$0.25 < \Phi$	0		
		area size (mm)		Acceptable number													
		$\Phi \leq 0.10$		ignore													
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		$0.25 < \Phi \leq 0.25$		1													
$0.25 < \Phi$	0																
2.2	line	<table border="1"> <thead> <tr> <th colspan="2">Size (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td>ignore</td> <td><math>W \leq 0.03</math></td> <td>ignore</td> </tr> <tr> <td><math>L \leq 4.0</math></td> <td><math>0.03 &lt; W \leq 0.04</math></td> <td>2</td> </tr> <tr> <td><math>L \leq 4.0</math></td> <td><math>0.04 &lt; W \leq 0.05</math></td> <td>1</td> </tr> <tr> <td></td> <td><math>0.05 &lt; W</math></td> <td>Treat with dot non-conformance</td> </tr> </tbody> </table>	Size (mm)		Acceptable number	ignore	$W \leq 0.03$	ignore	$L \leq 4.0$	$0.03 < W \leq 0.04$	2	$L \leq 4.0$	$0.04 < W \leq 0.05$	1		$0.05 < W$	Treat with dot non-conformance
		Size (mm)		Acceptable number													
		ignore	$W \leq 0.03$	ignore													
		$L \leq 4.0$	$0.03 < W \leq 0.04$	2													
		$L \leq 4.0$	$0.04 < W \leq 0.05$	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.