



FORMIKE ELECTRONIC CO.,LTD

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH018ST03-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			

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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.

Table Of Contents

List	Description	Page No.
0	Cover	1
0	Table Of Contents	2
1	Revision Record	3
2	General Description	4
3	External Dimensions	5
4	Interface Description	6
5	Absolute Maximum Ratings	7
6	Electrical Characteristics	8
7	Timing Characteristics	9
8	Backlight Characteristics	13
9	Optical Characteristics	14
10	Reliability Test Conditions And Methods	17
11	Inspection Standard	18
12	Handling Precautions	19
13	Precaution For Use	20

1. Revision record

[illegible]

2. General Description

2.1 Description

KWH018ST03-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 KWH018ST03-F01.

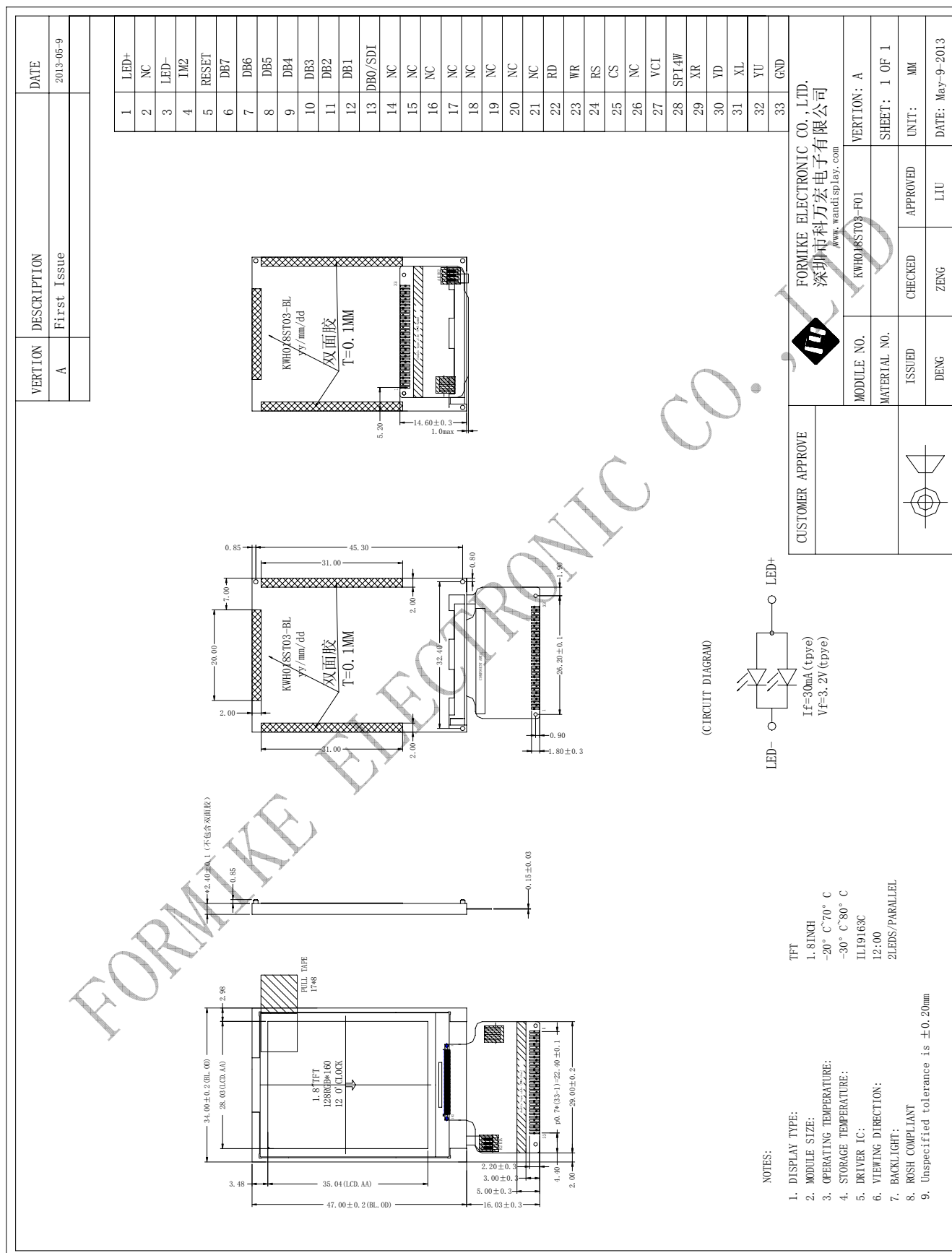
2.2 Application

Mobile phone, Multimedia products
 and other electronic Products
 Etc.

2.3 Features:

Features	Description	UNITS
LCD type	1.77" TFT	--
Dot arrangement	128 (RGB) × 160	dots
Driver IC	ILI9163C	--
Color Depth	65K/262K	
Interface	MCU 8-bits/3 Line or 4line SPI	
Module size	34.00(W) × 47.00 (H) × 2.40(T)	mm
Active area	28.032(W) × 35.04(H)	mm
Dot pitch	0.219 (W) × 0.219 (H)	mm
Back Light	2 White LED In parallel	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

3. External Dimensions



4. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	LED+	Power supply for LED backlight Anode input.
2	NC	NC.
3	LED-	Power supply for LED backlight Cathode input.
4	IM2	MCU parallel interface bus and serial interface select: IM2=1, 8-bit parallel interface IM2=0, serial interface
5	RESET	Reset input pin, When reset is "L", Initialization is executed.
6	DB7	Data input,in serial interface,they are not used and shuould be fixed at VCI or DGND level.
7	DB6	
8	DB5	
9	DB4	
10	DB3	
11	DB2	
12	DB1	
13	DB0/SDI	Data input,when SPI interface,as SDI.
14-21	NC	NC.
22	RD	Read strobe in 8080 MCU interface. If not used,please fix this pin at VCI or DGND level.
23	WR	Write enable in MCU parallel interfac. In 4-line SPI,this pin is used as D/CX(data/command selection) If not used,please fix this pin at VCI or DGND level.
24	RS	Display data/command selection pin MCU interface. RS=1,display data or parameter. RS=0,display command data . In serial interface,this is used as SCL.
25	CS	Chip select signal, Active "L"
26	NC	NC.
27	VCI	Power supply(+2.5V~~+3.6V)
28	SPI4W	SPI4W=0, 3-line SPI interface. SPI4W=1, 4-line SPI interface.
29	X+(XR)	Touch Panel Right Side Wire
30	Y+(YD)	Touch Panel Down Side Wire
31	X-(XL)	Touch Panel Left Side Wire
32	Y-(YU)	Touch Panel Up Side Wire
33	GND	GND

5. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9163C is used out of the absolute maximum ratings, the ILI9163C may be permanently damaged. To use the ILI9163C within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the ILI9163C will malfunction and cause poor reliability.

Item	Symbol	Unit	Value Note
Supply voltage	VPNL	V	-0.3 ~ + 4.8
Supply voltage (Logic)	VDDI	V	-0.3 ~ + 4.6
Supply voltage (Digital)	VCC	V	-0.3 ~ + 2.4
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.

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6. Electrical Characteristics

Item	Symbol	Unit	Condition	Min.	Typ.	Max.	Note
Power & Operation Voltage							
Analog Operating voltage	VPNL	V	Operating voltage	2.5	2.78	4.8	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
Input/Output							
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
VCOM Operation							
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
Source Driver							
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, VPNL=2.5 to 4.8V, AGND=GND=0V, Ta=-30 to 70°C (to +85°C no damage)

Note2: Please supply digital VDDI voltage equal or less than analog VPNL voltage. (VDDI ≤ VPNL)

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

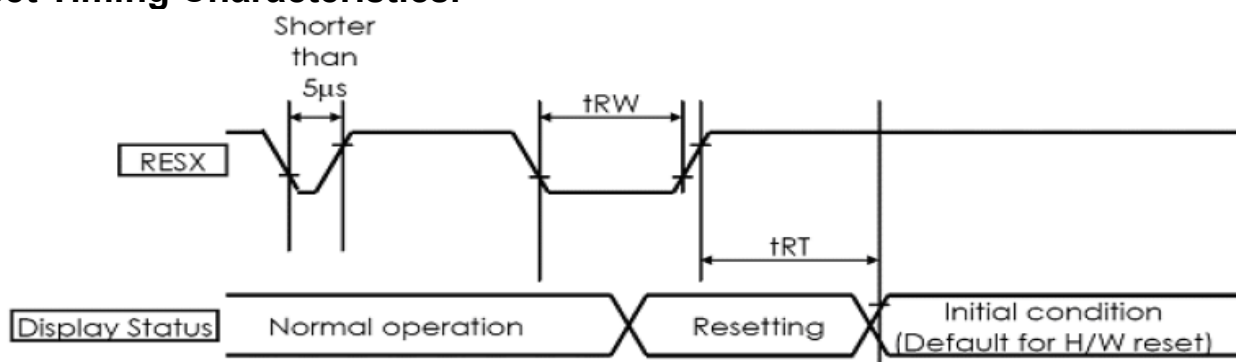
Note3: CSX, RDX, WRX, D[23:0], D/CX, RESX, TE, PCLK, VS, HS, DE, SDA, SCL, GM2, GM1, GM0, RCM1, RCM0, P68, IM2, IM1, IM0, SRGB, REV, SMX, SMY, RL, TB, IDM, SHUT, PREG, GS and Test pins.

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



7. Timing Characteristics.

7.1 Reset Timing Characteristics.



(V_{SS}=0V, V_{DDI}=1.65V to 1.95V, V_{PNL}=2.6V to 2.9V, T_a = -30 to 70°C)

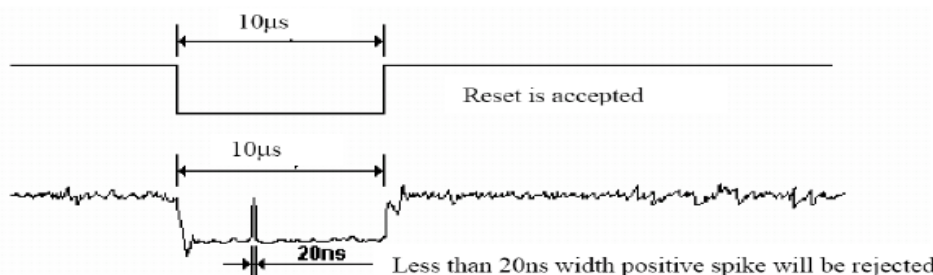
Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
t _{RESW}	*1) Reset low pulse width	RESX	10	-	-	-	μs
t _{REST}	*2) Reset complete width	-	-	-	5	When reset applied during Sleep in mode	ms
		-	-	-	120	When reset applied during Sleep out mode	ms

Note

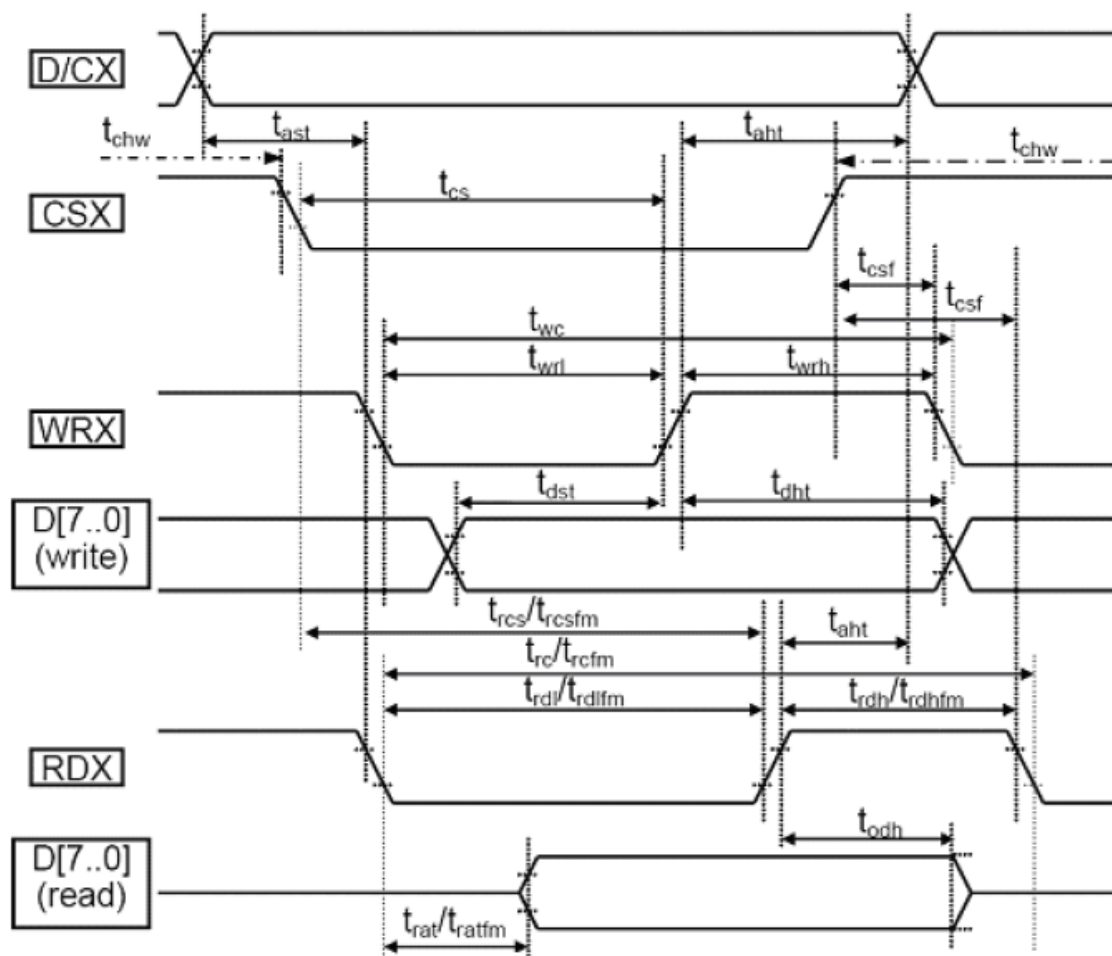
1. Spike due to an electrostatic discharge on RESX line does not cause system reset according to the table below.

RESX Pulse	Action
Shorten than 5μs	Reset Rejected
Longer than 10μs	Reset
Between 5μs and 10μs	Reset starts (It depends on voltage and temperature condition.)

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 Hardware 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 (t_{REST}) within 5ms after a rising edge of RESX.
4. Spike Rejection also applies during a valid reset pulse as shown below:



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



Signal	Symbol	Parameter	min	max	unit	description
D/CX	tast	Address setup time	0		ns	
	taht	Address hold time(Write/Read)	10		ns	
CSX	tchw	"S""H" Pulse Width	0		ns	
	tcs	Chip Select setup time (Write)	10		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)	10		ns	
WRX	twc	Write cycle	66		ns	
	twrh	Control pulse H duration	15		ns	
	twrl	Control pulse L duration	15		ns	
RDX	trc	Read cycle (ID)	160		ns	When read ID

	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

7.3. 3-line serial Interface Timing Characteristics.

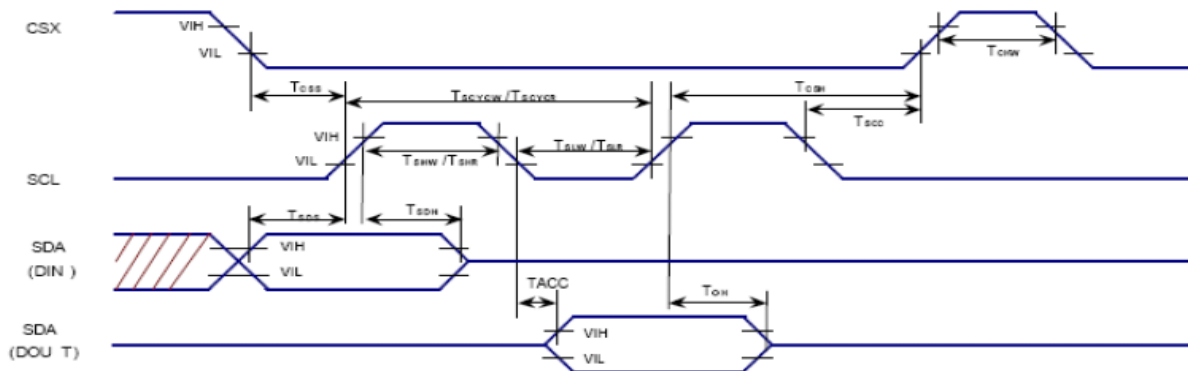


Table 17.3.2.1: 3-pin Serial Interface Characteristics

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)	Tds	Data setup time	5		ns	
	Tdh	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, VPNL=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.

7.4. 4-line serial Interface Timing Characteristics.

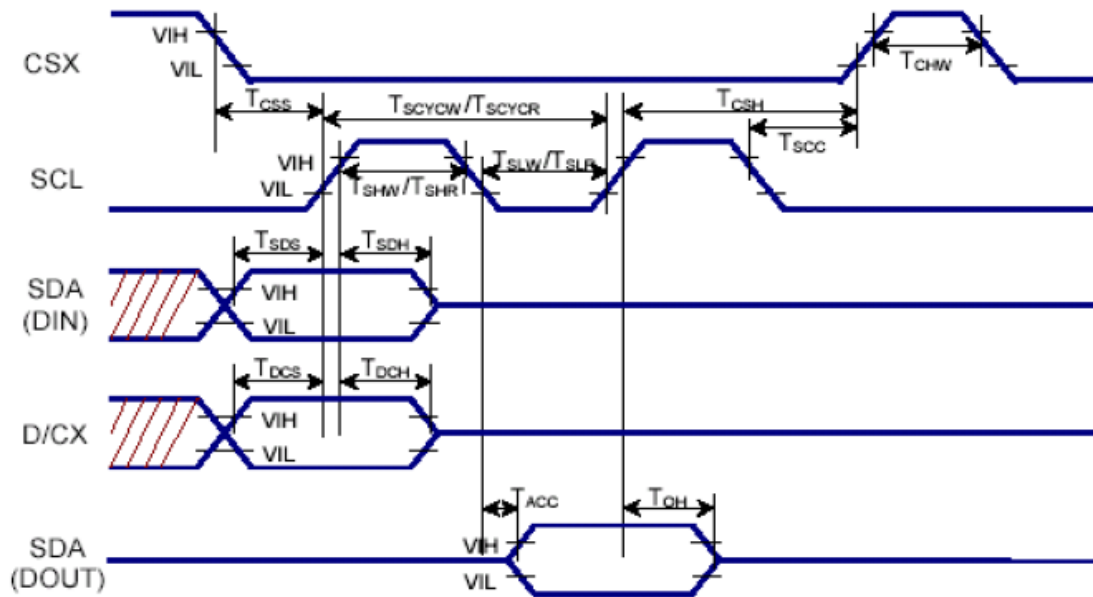


Table 17.3.2.2: 4 pin Serial Interface Characteristics

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time	10		ns	
	T_{CSH}	Chip select hold time	30		ns	
	T_{CHW}	Chip select "H" pulse width	30		ns	
SCL	$T_{SCYC W}$	Serial clock cycle(Write)	66		ns	
	T_{SHW}	S"L""H" pulse width(Write)	15		ns	
	T_{SLW}	S"L""L" pulse width(Write)	15		ns	
	$T_{SCYC R}$	Serial clock cycle(Read)	150		ns	
	T_{SHR}	S"L""H" pulse width(Read)	60		ns	
	T_{SLR}	S"L""L" pulse width(Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	5		ns	
	T_{DCH}	D/CX hold time	5		ns	
SDA(DIN) (DOUT)	T_{SDS}	Data setup time	5		ns	
	T_{SDH}	Data hold time	5		ns	
	T_{ACC}	Access time	5	50	ns	For maximum $C_L = 30\text{pF}$
	T_{OH}	Output disable time	10		ns	For minimum $C_L = 8\text{pF}$

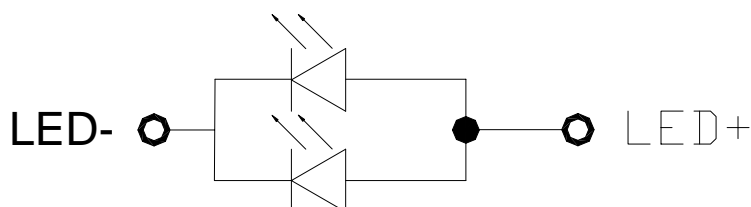
Note 1: $V_{DDI}=1.65$ to 3.3V , $V_{PNL}=2.6$ to 3.3V , $AGND=GND=0\text{V}$. $T_a=-30$ to 70°C (to $+85^\circ\text{C}$ no damage)

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

Logic high and low levels are specified as 10% and 90% of V_{DDI} for Input signals.

8. Backlight Characteristics.

(CIRCUIT DIAGRAM)



$I_f=30\text{mA}(\text{tpye})$
 $V_f=3.2\text{V}(\text{tpye})$

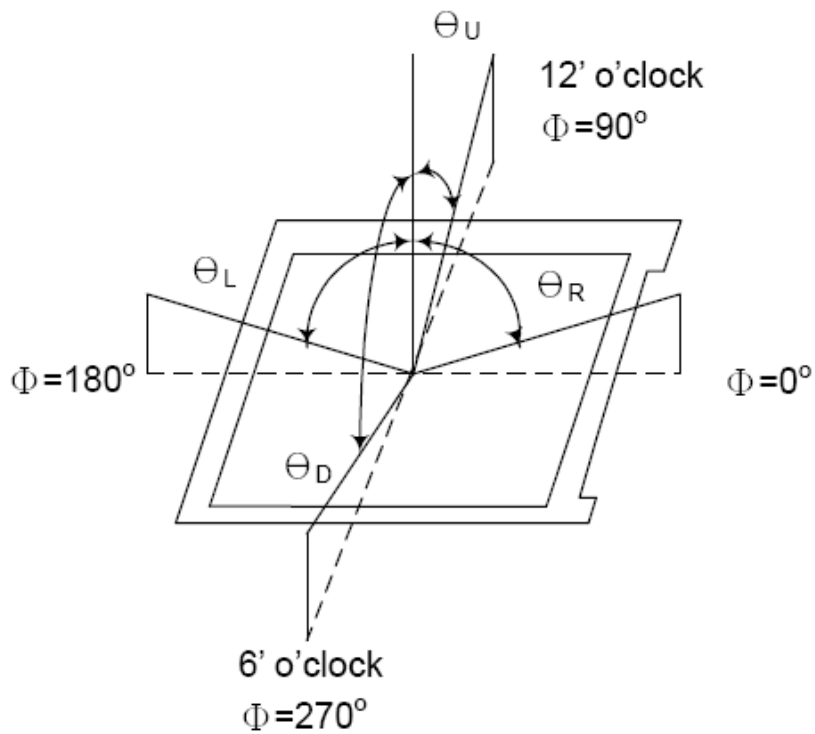
Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	3.0	3.2	3.4	V	If=30 mA	-
Supply Current	If	-	30	-	mA	-	-
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	96	-	mW	-	
Luminous Intensity for LCM		-	230	-	Cd/m²	If=30 mA	
Uniformity for LCM	-	80	-	-	%	If=30 mA	
Life Time	-	50000	-	-	Hr	If=30 mA	-
Backlight Color	White						

9.Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)		T(%)	—	—	19.1	—	—	
Contrast Ratio		CR	$\Theta=0$	400	500	—	—	(1)(2)
Response time	Rising	T _R	Normal viewing angle — —	—	2	4	msec	(1)(3)
	Falling	T _F		—	6	12		
				—				
Color gamut		S(%)			60		%	
Color chromaticity (CIE1931)	White	W _x		0.283	0.303	0.323		(1)(4) CF glass
		W _y		0.305	0.325	0.345		
	Red	R _x		0.606	0.626	0.646		
		R _y		0.314	0.334	0.354		
	Green	G _x		0.257	0.277	0.297		
		G _y		0.529	0.549	0.569		
	Blue	B _x		0.122	0.142	0.162		
		B _y		0.102	0.122	0.142		
Viewing angle	Hor.	Θ_L	CR>10	35	45	—		
		Θ_R		35	45	—		
	Ver.	Θ_U		35	45	—		
		Θ_D		10	20	—		
Optima View Direction		12 O'clock						(5)



Note (1) Definition of Viewing Angle :

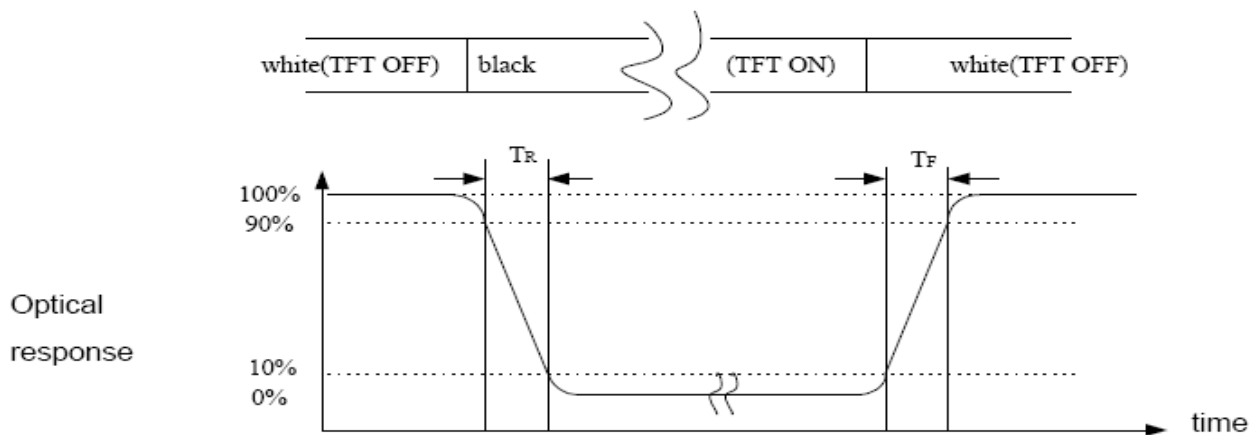


Note (2) Definition of Contrast Ratio(CR) :
measured at the center point of panel

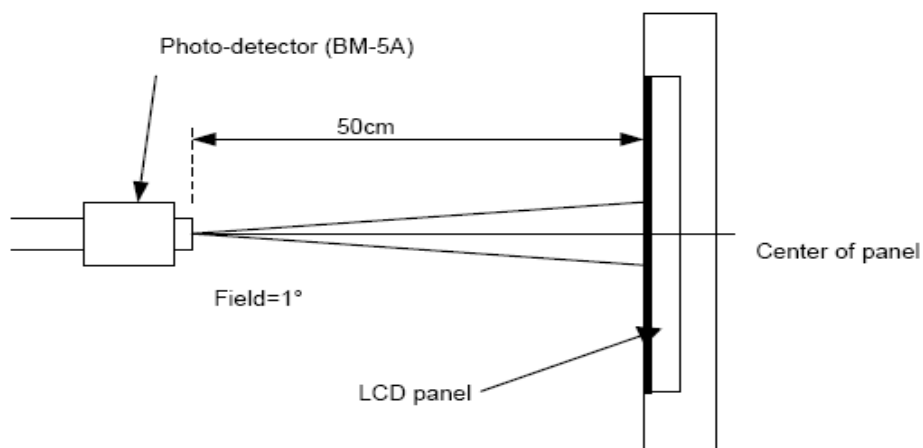
$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

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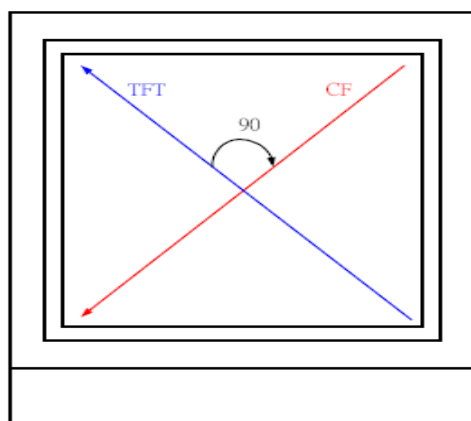
Note (3) Definition of Response Time : Sum of T_R and T_F



Note (4) Definition of optical measurement setup



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



10. 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,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	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 200\text{Hours}$	
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)	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C}$ $80^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (30min) (5min) (30min) $\xrightarrow{\text{1cycle}}$ 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>10M Ω) 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.

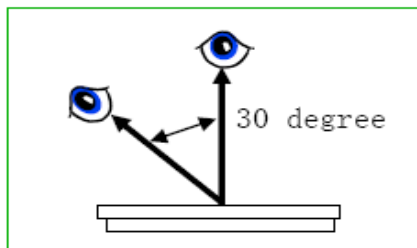
6, Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

11. 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	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	minor														
		<table><tr><td>area size (mm)</td><td>Acceptable number</td></tr><tr><td>$\Phi \leq 0.10$</td><td>ignore</td></tr><tr><td>$0.10 < \Phi \leq 0.15$</td><td>3</td></tr><tr><td>$0.15 < \Phi \leq 0.20$</td><td>2</td></tr><tr><td>$0.25 < \Phi \leq 0.25$</td><td>1</td></tr><tr><td>$0.25 < \Phi$</td><td>0</td></tr></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													
		$0.10 < \Phi \leq 0.15$		3													
		$0.15 < \Phi \leq 0.20$		2													
		$0.25 < \Phi \leq 0.25$		1													
$0.25 < \Phi$	0																
2.2	line	<table><tr><td colspan="2">Size (mm)</td><td>Acceptable number</td></tr><tr><td>ignore</td><td>$W \leq 0.03$</td><td>ignore</td></tr><tr><td>$L \leq 4.0$</td><td>$0.03 < W \leq 0.04$</td><td>2</td></tr><tr><td>$L \leq 4.0$</td><td>$0.04 < W \leq 0.05$</td><td>1</td></tr><tr><td></td><td>$0.05 < W$</td><td>Treat with dot non-conformance</td></tr></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															

12. Handling Precautions

12.1 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.

12.2 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.

12.3 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.

12.4 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

12.5 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.

12.6 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

12.7 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

13. Precaution For Use

13.1

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.

13.2

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.