

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH017ST13-C01 Version: 1.0

【 】 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

KWH017ST13-C01 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, backlight and CTP unit . The following table described the features of FORMIKE KWH017ST13-C01.

1.2 Application

Smart Watch, Multimedia products
and other electronic Products
Etc.

1.3 Features:

Features	Description	UNITS
LCD type	1.69" TFT	--
Dot arrangement	240 (RGB) × 280	dots
Driver IC	JD9851A	--
Color Depth	262K	
Interface	MCU 8bit	
Module size	34.70(W) × 40.70(H) × 3.51(T)	mm
Active area	27.97(W) × 32.63(H)	mm
Dot pitch	0.11655 (W) × 0.11655 (H)	mm
CTP Structure	OGS(OCA bonding with LCM)	
Back Light	3 White LEDs	--
With/Without TSP	With TSP	
Weight(g)	TBD	

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	MODULE NO.	K1MH075T13-C01	VERSION: B
	MATERIAL NO.		SHEET: 3 OF 3
	ISSUED	CHECKED	APPROVED
	LEO	ZENG	LU
		DATE: Sept-01-2020	

3. Interface Description

LCM:

PIN NO.	PIN NAME	DESCRIPTION
1-6	D7-D2	8 bit 8080 MCU data bus.
7	LEDK	Cathode pin for backlight.
8	LEDA	Anode pin for backlight.
9	GND	System ground.
10	LCD_RS	Data/command selection pin in MCU parallel interface.
11	LCD_TE	Tear effect signal.
12	LCD_RESET	Reset pin for LCD system.
13	LCD_RD	Read enable in MCU parallel interface.
14	LCD_WR	Write enable in MCU parallel interface.
15	LCD_CS	Chip select input pin.
16	GND	System ground.
17	VDD	Power supply for system (+2.5V~+3.3V).
18	TP_RESET	Reset pin for CTP system.
19	VDD	Power supply for system (+2.5V~+3.3V).
20	TP_INT	Interrupt pin for CTP system .
21	TP_SDA	Data input/output pin in 4W serial interface.
22	TP_SCL	Clock signal pin.
23-24	D0-D1	8 bit 8080 MCU data bus.

4. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for system	V_{DD}	-0.3	4.6	V
Operating temperature	T_{OP}	-20	+70	°C
Storage temperature	T_{ST}	-30	+80	°C

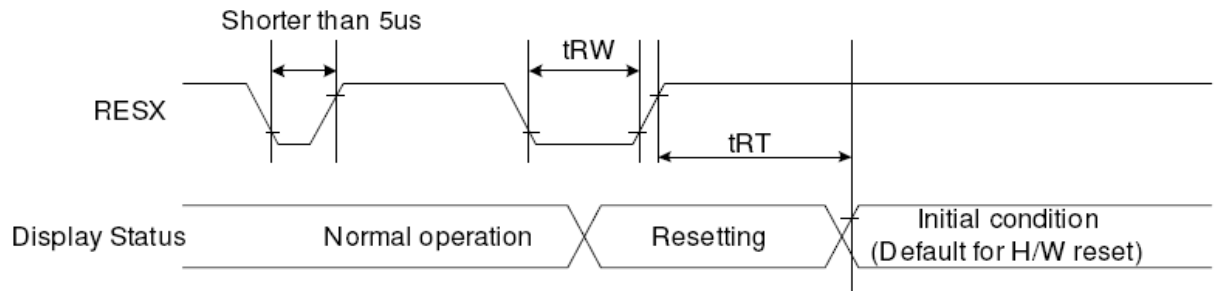
Note:
If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded.
Absolute maximum ratings, therefore specify the values exceeding which the product may be physically damaged.
Be sure to use the product within the range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

5. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
Supply voltage for system	V_{DD}	2.5	3.3	3.5	V	VDD
Input voltage	V_{IL}	0	-	$0.3V_{DD}$	V	RS,WR,RD,CS, RESET,SCL,SDA ,INT,DB0-7
	V_{IH}	$0.7 V_{DD}$	-	V_{DD}	V	

6.Timing Characteristics.

6.1 Reset Timing Characteristics.



Signal	Symbol	Parameter	Min	Max	Unit
RESX	t_{RW}	Reset pulse duration	10		μS
	t_{RT}	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

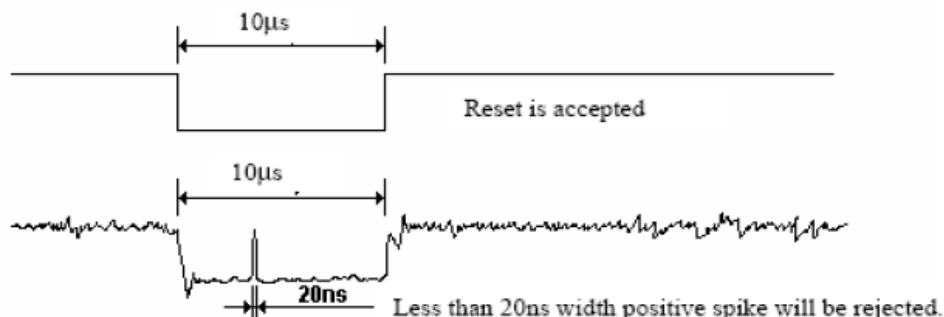
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (t_{RT}) within 5 ms after a rising edge of RESX.

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:



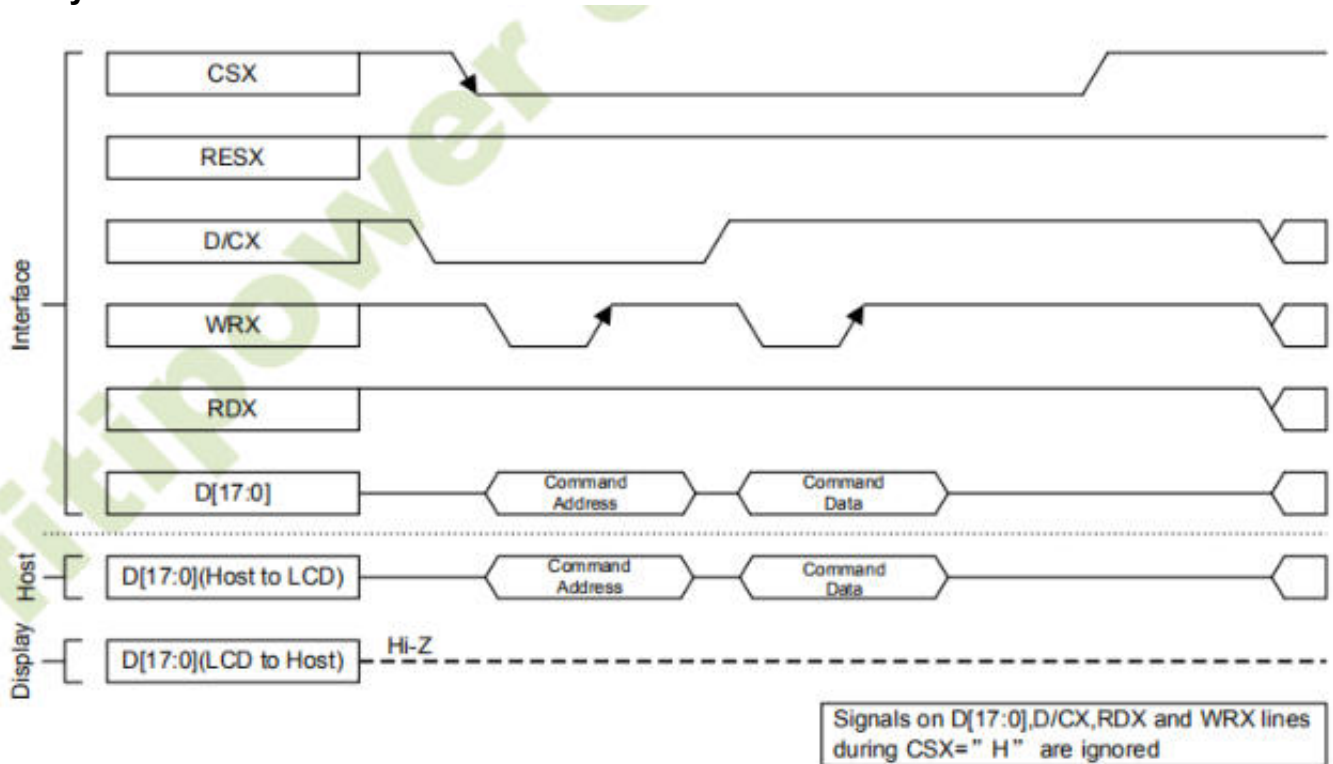
Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

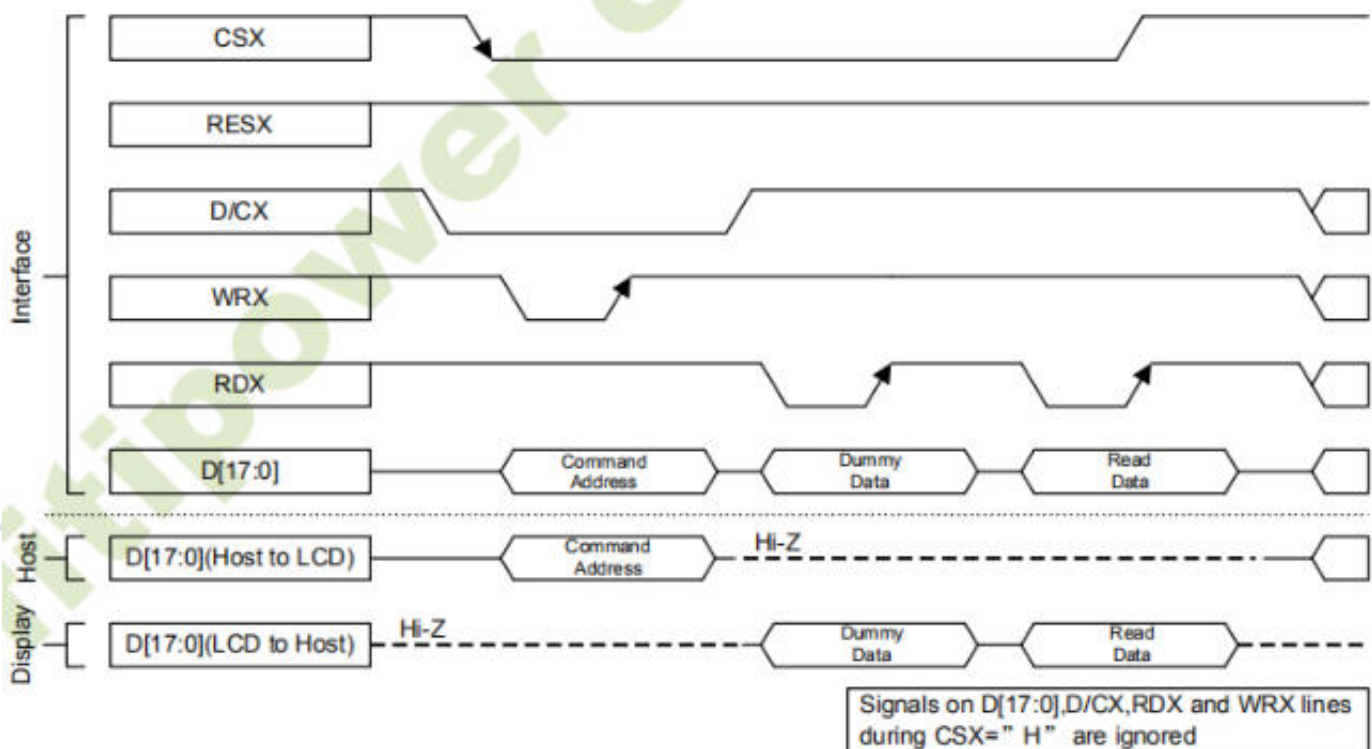
Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

6.2. 8080 MCU Interface Timing Characteristics.

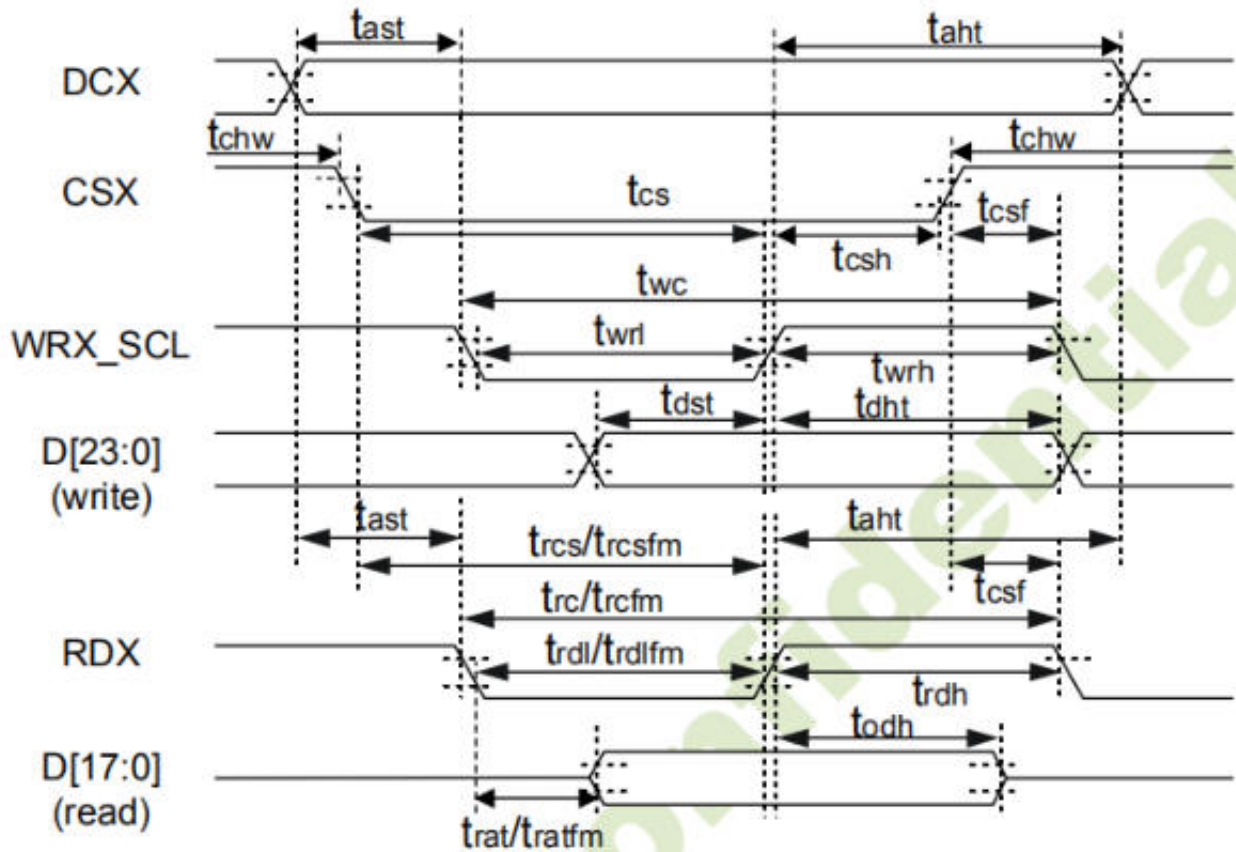
Write cycle:



Read cycle:



Timing Characteristics:



Note: $T_a = 25^\circ\text{C}$, $V_{DD} = 2.8\text{V}$, $GND = 0\text{V}$

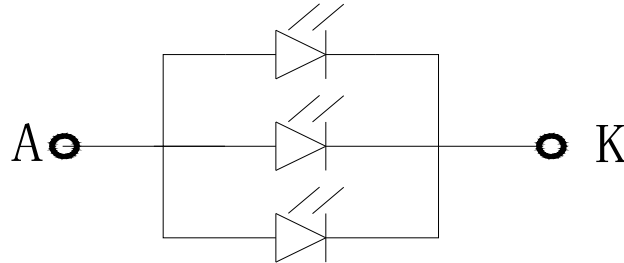
Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX	t _{ast}	Address setup time	0	-	ns	
	t _{ah}	Address hold time (write/read)	10	-	ns	
CSX	t _{chw}	CSX "H" Pulse Width	0		ns	
	t _{cs}	Chip select setup time (write)	15		ns	
	t _{rcs}	Chip select setup time (read ID)	45		ns	
	t _{rcsfm}	Chip Select setup time (read FM)	355		ns	
	t _{csf}	Chip select wait time (write/read)	10		ns	
	t _{csh}	Chip select hold time	10		ns	
	t _{wc}	Write cycle	66		ns	
WRX	t _{wrh}	Control pulse "H" duration	15		ns	
	t _{wrl}	Control pulse "L" duration	15		ns	
RDX(ID)	t _{rc}	Read cycle (ID)	160		ns	
	t _{rdh}	Control pulse "H" duration (ID)	90		ns	
	t _{rdl}	Control pulse "L" duration (ID)	45		ns	
RDX(FM)	t _{rcfm}	Read cycle (FM)	450		ns	
	t _{rdhfm}	Control pulse "H" duration (FM)	90		ns	
	t _{rdlfm}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T _{dst}	Data setup time	10		ns	
	t _{dht}	Data hold time	10		ns	
	t _{rat}	Read access time (ID)		42	ns	
	t _{ratfm}	Read access time (FM)		340	ns	
	t _{odh}	Output disable time	20	80	ns	

6.3 Touch panel IIC timing.

Item	Description
Interface	IIC
Touch Linearity	3%
Surface hardness	≥6H
Transmittance	≥85%
Structure type	OGS(one glass structure)
Lifetime	≥1,000,000 times
Driver IC	CST816D
Touch points	1 finger and gesture

Item	Symbol	Min	Typ	Max	Unit
Operating Current (Dynamic Mode)	I _{DM}	-	5.0	-	mA
Operating Current (Monitoring Mode)	I _{MM}	-	500@50HZ	-	uA
Operating Current (Standby Mode)	I _{SM}	-	500@50HZ	-	uA
Operating Current (Sleep Mode)	I _{SLM}	-	10	-	uA

7. Backlight Characteristics.



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	2.9	3.2	3.3	V	If=60 mA	-
Supply Current	If	-	60	-	mA	-	-
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	192	-	mW	-	
Luminous Intensity for LCM		250	300	-	Cd/m2	If=60 mA	
Uniformity for LCM	-	80	-	-	%	If=60 mA	
Life Time	-	20000	-	-	Hr	If=60 mA	-
Backlight Color	White						

8.Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark
Response time	Tr+ Tf	$\theta=0^\circ$ $\phi=0^\circ$	---	25	30	ms	Note2
Contrast ratio	Cr		600	800	---	---	Note3
Transmittance (with POL)	T		3.2	4.3	---	%	C light
Viewing angle range (CR $\geq$ 10)	θ	$\phi = 90^\circ$	80	---	---	deg	Note4
		$\phi = 270^\circ$	80	---	---	deg	
		$\phi = 0^\circ$	80	---	---	deg	
		$\phi = 180^\circ$	80	---	---	deg	
NTSC	---	---	---	50	---	%	
CIE(x,y) chromaticity	Red	x	0.562	0.612	0.662	---	Note5 CF glass (C light)
		y	0.281	0.331	0.381		
	Green	x	0.233	0.283	0.333		
		y	0.479	0.529	0.579		
	Blue	x	0.093	0.143	0.193		
		y	0.084	0.134	0.184		
	White	x	0.251	0.301	0.351		
		y	0.277	0.327	0.377		

Note1. Measuring Condition

- (1) Measuring surrounding: dark room
- (2) Ambient temperature: Ta=25°C
- (3) 15min. warm-up time

Note2. Response time is the time required for the display to transition from Black to White (Rise Time, Tr) and from White to Black (Decay Time, Tf). The measurement instrument is DMS-803. For more information, please refer to FIG 1 and FIG 2.

Note3. Contrast Ratio (CR) is defined mathematically as below. Measured at the center point of panel by DMS-803, please refer to FIG 1

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

Note4. Viewing angle is the angle at which the contrast ratio is greater than 10($CR \geq 10:1$). The measurement instrument is DMS-803. For more information, please refer to FIG 1 and FIG 3.

Note5. CIE (x, y) chromaticity for CF only, measured with Olympus MHL-450 under C light.

FIG. 1 DMS-803 Measurement Set-Up

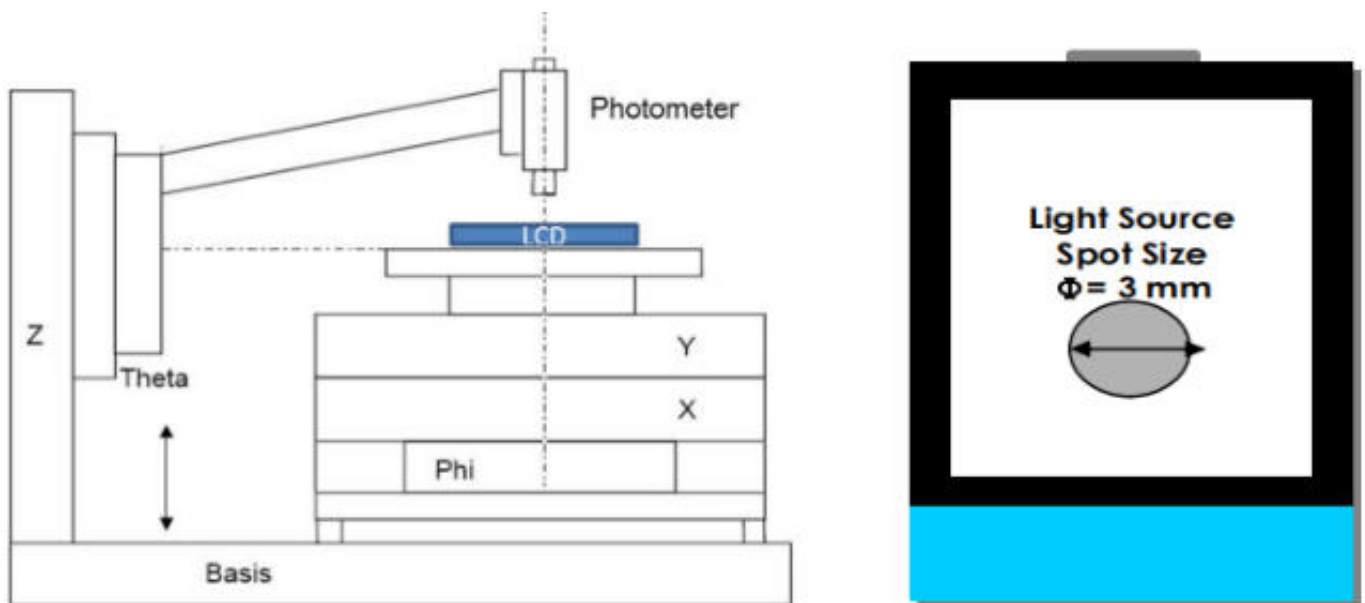


FIG. 2 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”. This definition is valid for a normally black display. For a normally white display the opposite definition applies.

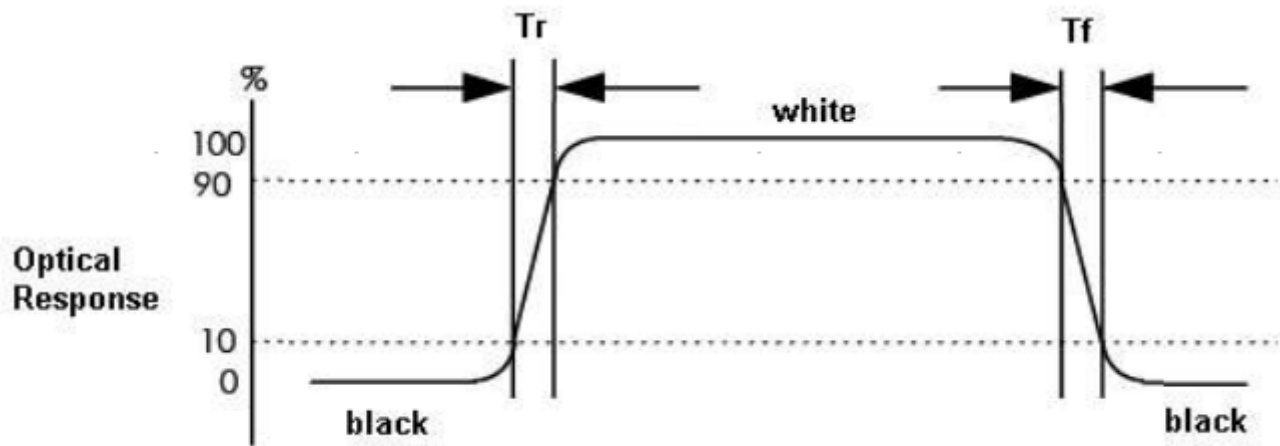
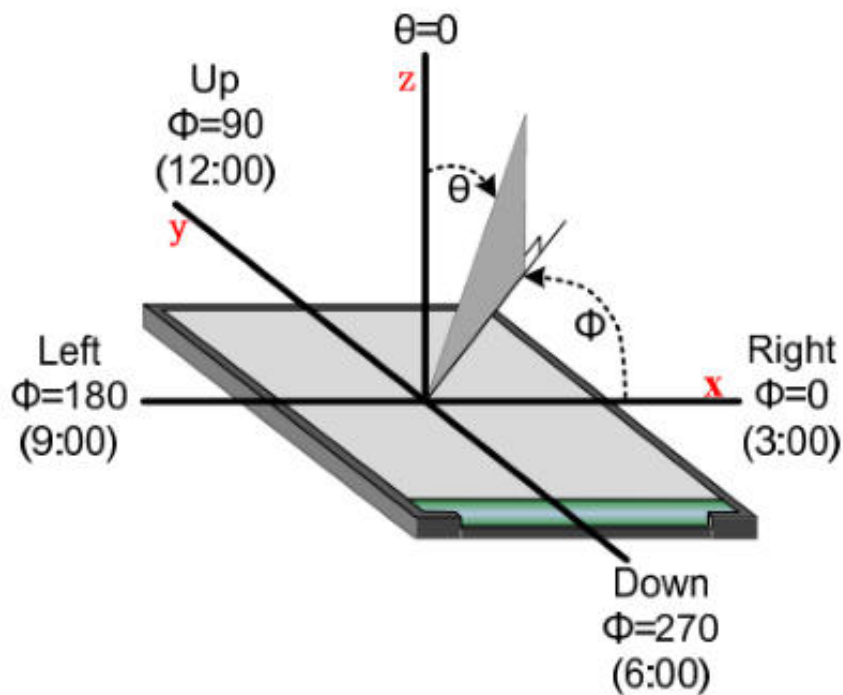


FIG. 3 The definition of viewing angle



9. RELIABILITY

No.	Test Item	Test Condition	Remark
1	High Temperature Storage	+80℃± 2℃, 96 hrs	Note
2	Low Temperature Storage	-30℃± 2℃, 96 hrs	Note
3	High Temperature Operation	+70℃± 2℃, 96 hrs	Note
4	Low Temperature Operation	-20℃± 2℃, 96 hrs	Note
5	High Temperature & High Humidity Storage Test	+50℃± 5℃, 90%R.H, 96 hours	Note
6	Temperature Cycle (non operation)	-30℃ ← +25℃ → +80℃ (30mins ← 5mins → 30mins) 10 Cycles	Note

Note : Recovery Time should be 2~4 hours at room temperature (20±8℃) and humidity (below 60% R.H). No abnormalities in functions and appearance

10.INSPECTION CRITERION

10.1 Scope

Display Quality Evaluation
Mechanics Specification

10.2 Sampling Plan

MIL-STD-105E

Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E
Lot size: Quantity per shipment as one lot (different model as different lot).

Sampling type: Normal inspection, single sampling

Sampling level: Level II.

10.3 Acceptable Quality Level

Item	Major	Minor
Appearance	1.0%	1.5%
Electrical	0.65	1.0%

10.3.1 Classification of defects:

10.3.1.1Major defect

Any defect may result in functional failure, or reduce the usability of product for its purpose. For Example: Electrical failure, deformation and etc.

10.3.1.2 Minor defect

The criteria on major or minor judgment will be according with the classification of defects.

10.4 Panel Inspection Condition

10.4.1 Environment:

10.4.2 Room Temperature: $25 \pm 5^{\circ}$ C.

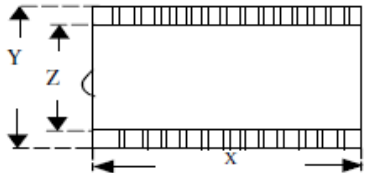
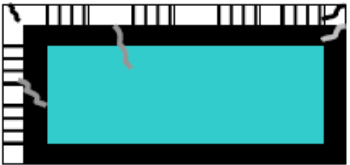
10.4.3 Humidity: $50 \pm 20\%$ RH.

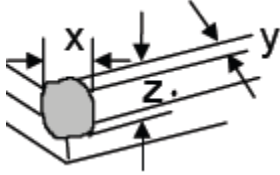
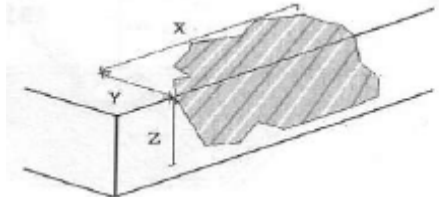
Illumination: 300 ~ 700 Lux.

10.4.4 Inspection Distance: 35 ± 5 cm

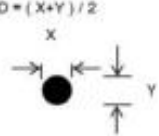
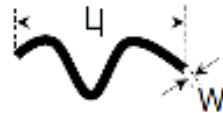
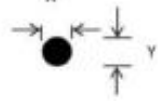
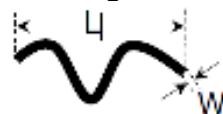
10.5 TFT Inspection Criteria

10.5.1 Visual inspection criterion in cosmetic / appearance

Glass defect			
N o	Item	Criteria	Remark
1	Dimension (Minor)	By engineering diagram	
2	Crack (Major)	Extensive crack	

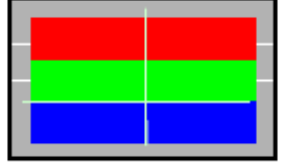
3	Corner (Minor)	$X \leq 1/2 T$ $Y \leq 1/2 T$ $Z \leq T$	 T: Glass thickness Z: Thickness X: Length Y: Width
4	Side (Minor)	X Ignore $Y \leq 1/2 T$ $Z \leq T$	 T: Glass thickness Z: Thickness X: Length Y: Width

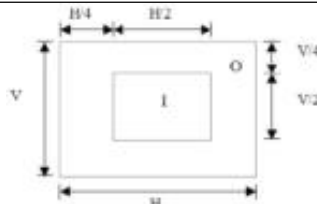
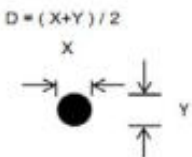
TFT defect in appearance

No	Item	Criteria	Remark
1	Foreign Spot (Minor) Including: Black spot, White spot Pin hole Foreign particle	$D \leq 0.10\text{mm}$, Ignore $0.10\text{mm} < D \leq 0.15\text{mm}$, $N \leq 2$ $0.15\text{mm} < D \leq 0.20\text{mm}$, $N \leq 1$ $0.2\text{mm} < D$, $N = 0$ Distance $\geq 5\text{mm}$ Ignore if out of Area AA	$D = (X+Y)/2$, X: Length, Y: Width 
2	Foreign Line(Minor) Including: Black line White line Bright line	$W \leq 0.03\text{mm}$, Ignore $0.03\text{mm} < W \leq 0.05\text{mm}$, $L \leq 2\text{mm}$, $N \leq 2$ $W > 0.05\text{mm}$, $N = 0$ Ignore if out of Area AA	L: Length, W: Width 
3	Polarizer Dent/Air Bubble (Minor)	$D \leq 0.10\text{mm}$, Ignore $0.10\text{mm} < D \leq 0.15\text{mm}$, $N \leq 2$ $0.15\text{mm} < D \leq 0.20\text{mm}$, $N \leq 1$ $0.2\text{mm} < D$, $N = 0$ Distance $\geq 5\text{mm}$ Ignore if out of Area AA	$D = (X+Y)/2$, X: Length, Y: Width 
4	Polarizer Scratches (Minor)	$W \leq 0.03\text{mm}$, Ignore $0.03\text{mm} < W \leq 0.05\text{mm}$, $L \leq 2\text{mm}$, $N \leq 2$ $W > 0.05\text{mm}$, $N = 0$ Ignore if out of Area AA	L: Length, W: Width 

Other defects			
No	Item	Criteria	Remark
1	FPC (Minor)	Any crack or breakage which effect the function are not allowed Disregard if the dirty removed	
2	Backlight (Minor)	Power up is allowed. Breaking off is not allowed. The scratch which may causes a problem in practical use is not allowed	
3	Bezel (Minor)	Erasable dirt is ignore	

10.5.2 Visual inspection criterion in electrical display

Glass defect			
No	Item	Criteria	Remark
1	No display (Major) Abnormally Short circuit	Not allowed	
2	Missing line (Major)	Not allowed	
3	Darker or lighter line (Major)	Not allowed	
4	Weak line (Minor)	By limit sample	

Display Inspection						
No	Item	Criteria				Remark
1	Bright / Dark dot	Items	Area I	Area O	Tota I	 1.1sub-pixel: 1R or 1G or 1B 2.Point defect area ≥ 1/2 sub pixel
		Bright	1	1	1	
		Dark	1	3	3	
		Bright & Dark	2	3	4	
		2 adjacent dots	0	0	0	
		Minimum Distance ≥ 5mm				
2	Tiny bright dot	Visible through 6% ND filter D≤0.10mm, Ignore 0.10mm<D≤0.15mm, N≤2 0.15mm<D≤0.20mm, N≤1 0.2mm<D, N=0 Distance≥5mm Ignore if out of Area AA				D =(X+Y)/2, X: Length, Y: Width 
4	Mura/Waving/ Hot spot	Not visible through 6% ND filter in 50% gray or judge by limit sample if necessary				

* Note:

- Defect which is on the Black Matrix (outside of active area) are not considered as a defect.
- If any specific defect is not included in the above defect table, this defect should be judged by Formike.
- W: Width, L: Length D: Average Diameter N: Count.

11. PRECAUTION RELATING & PRODUCT HANDLING

Display is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification.

11.1 SAFETY

11.1.1 If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin.

11.1.2 If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

11.2 HANDLING

11.2.1 Avoid any strong mechanical shock which can break the glass.

11.2.2 Avoid static electricity which can damage the CMOS LSI - When working with the module, be sure to ground your body and any electrical equipment you may be using. The followings should be noted:

11.2.2.1 CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.

11.2.2.2 Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

11.2.2.3 Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.

11.2.2.4 The modules should be kept in anti-static bags or other containers resistant to static for storage.

11.2.2.5 Only properly grounded soldering irons should be used.

11.2.2.6 If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.

11.2.2.7 The normal static prevention measures should be observed for work clothes and working benches.

11.2.3.8 Since dry air is inductive to static, a relative humidity of 50-60% is recommended

11.2.3 Do not remove the panel or frame from the module.

11.2.4 The polarizing plate of the display is very fragile. Please handle it very carefully, do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass, tweezers, etc.)

11.2.5 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.

11.2.6 Do not touch the display area with bare hands, this will stain the display area.

11.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

11.2.8 To control temperature and time of soldering is $300 \pm 10^{\circ}\text{C}$ and 3-4 sec.

To avoid liquid (include organic solvent) stained on LCD Module.

11.3 STORAGE

11.3.1 Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the humidity is below 60% RH.

11.3.2 Avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.3.3 Do not place the module near organic solvents or corrosive gases.

Do not crush, shake, or jolt the module.

11.4 LIMITED WARRANTY

11.4.1 FORMIKE modules are not consumer products, but may be incorporated by FORMIKE's customers into consumer products or components thereof, FORMIKE does not warrant that its modules and components are fit for any such particular purpose.

11.4.2 The liability of FORMIKE is limited to repair or replacement on the terms set forth below. FORMIKE will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between FORMIKE and the customer, FORMIKE will only replace or repair any of its Modules which is found defective electrically or visually when inspected in accordance with FORMIKE INSPECTION CRITERIA

11.4.3 No warranty can be granted if any of the precautions state in handling liquid crystal display has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.

11.4.4 In returning the modules, they must be properly packaged; there should be detailed description of the failures or defect.

12. OTHERS

12.1 If there is any not specified quality standard in this specification as well as RMA , please refer to < INSPECTION CRITERIA>. Contact FORMIKE to get the complete <INSPECTION CRITERIA> by the contact window or feedback@wandisplay.com.

12.2 Special agreement of <INSPECTION CRITERIA> is recognized only in writhing between FORMIKE and the customer also indicated it before ordering.