PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH020ST23-F01 Version: 1.0

【　　】 Preliminary Specification
【 ◆ 】 Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATE:

●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
LEO			

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.

Issued Date:05-12-2020

Revision record

VER NO.	VER DATE	CONTENTS	Note
V1.0	2020-05-12	NEW ISSUE	LEO

Table Of Contents

1. General Description

1.1 Description

KWH020ST23-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 KWH020ST23-F1.
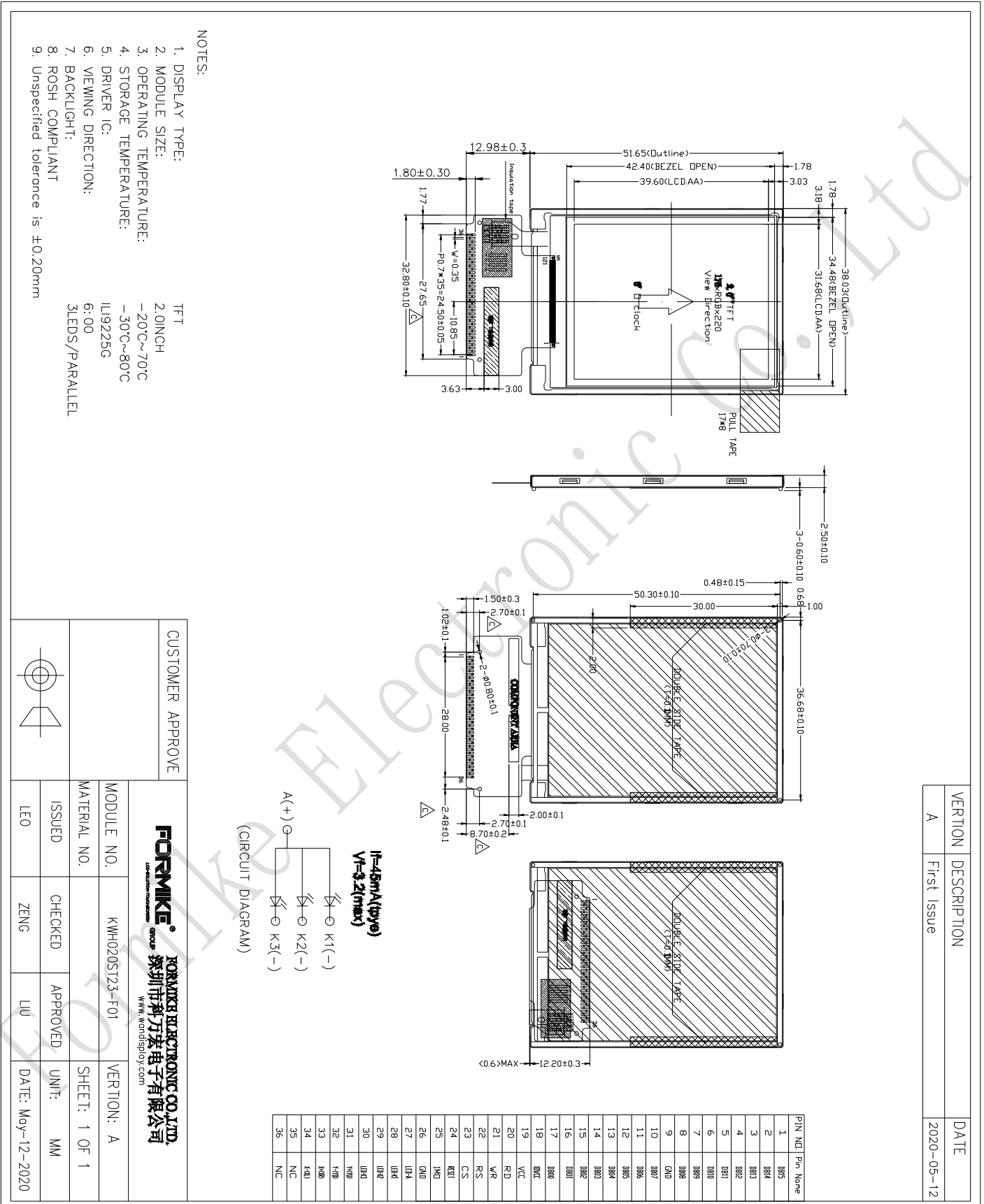
1.2   Application

Mobile phone, Multimedia products
and other electronic Products
Etc.

1.3   Features:

Features	Description	UNITS
LCD type	2.0"TFT	--
Dot arrangement	176（RGB）×220	dots
Driver IC	ILI9225G	--
Color Depth	65K	
Interface	CPU 8/16 bits	
Module size	39.35(W) ×50.18 (H)×2.50(T)	mm
Active area	31.68(W) ×39.60(H)	mm
Dot pitch	0.18 (W) ×0.18 (H)	mm
Back Light	3 White LED In parallel	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

2. External Dimensions

NOTES:
1. DISPLAY TYPE: TFT
2. MODULE SIZE: 2.0INCH
3. OPERATING TEMPERATURE: −20°C~70°C
4. STORAGE TEMPERATURE: −30°C~80°C
5. DRIVER IC: ILI9225G
6. VIEWING DIRECTION: 6:00
7. BACKLIGHT: 3LEDS/PARALLEL
8. ROSH COMPLIANT
9. Unspecified tolerance is ±0.20mm

(CIRCUIT DIAGRAM)

IF=45mA(type)
VF=3.2(max)

A(+)
K1(−)
K2(−)
K3(−)

PIN NO.	Pin Name
1	DB15
2	DB14
3	DB13
4	DB12
5	DB11
6	DB10
7	DB09
8	DB08
9	GND
10	DB07
11	DB06
12	DB05
13	DB04
14	DB03
15	DB02
16	DB01
17	DB00
18	GND
19	DVCC
20	VCC
21	R-D
22	WR
23	RS
24	CS
25	IM0
26	RESET
27	GND
28	LEDA
29	LEDA
30	LEDA
31	LEDK0
32	LEDK1
33	LEDK2
34	K-IM1
35	NC
36	NC

CUSTOMER APPROVE		
LED	ISSUED	ZENG
MODULE NO.	CHECKED	LIU
MATERIAL NO.	APPROVED	

FORMIKE ELECTRONIC CO.,LTD.
深圳市科万达电子有限公司
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MODULE NO.	VERSION: A
KWH020ST23-F01	
SHEET: 1 OF 1	UNIT: MM
DATE: May-12-2020	

VERTION	DESCRIPTION	DATE
A	First Issue	2020-05-12

3. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	DB15	80-system-16-Bit Data Bus.
2	DB14	80-system-16-Bit Data Bus.
3	DB13	80-system-16-Bit Data Bus.
4	DB12	80-system-16-Bit Data Bus.
5	DB11	80-system-16-Bit Data Bus.
6	DB10	80-system-16-Bit Data Bus.
7	DB9	80-system-16-Bit Data Bus.
8	DB8	80-system-16-Bit Data Bus.
9	GND	Ground.
10	DB7	80-system-16-Bit Data Bus.
11	DB6	80-system-16-Bit Data Bus.
12	DB5	80-system-16-Bit Data Bus.
13	DB4	80-system-16-Bit Data Bus.
14	DB3	80-system-16-Bit Data Bus.
15	DB2	80-system-16-Bit Data Bus.
16	DB1	80-system-16-Bit Data Bus.
17	DB0	80-system-16-Bit Data Bus.
18	IOVCC	Logic I/O Power supply voltage (+1.65V~+3.6V).
19	VCC	Driver power supply voltage (+2.5V~+3.6V).
20	RD	Read signal input, Active" L "
21	WR	Write signal input, Active" L "
22	RS	Command / Display data selection 0: command; 1: display data
23	CS	Chip select signal, Active "L"
24	RESET	Reset input pin, When reset is "L", Initialization is executed.
25	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.
26	GND	Ground.
27	LED-A	Power supply for LED backlight Anode input.
28	LED-K1	Power supply for LED backlight Cathode input.
29	LED-K2	Power supply for LED backlight Cathode input.
30	LED-K3	Power supply for LED backlight Cathode input.
31	Y+(YU)	Touch Panel Up Side Wire(NC).
32	Y-(YD)	Touch Panel Down Side Wire(NC).
33	X+(XR)	Touch Panel Right Side Wire(NC).
34	X-(XL)	Touch Panel Left Side Wire(NC).
35	NC	NC.
36	NC	NC.

4. Absolute Maximum Ratings

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

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

5. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
Supply voltage	V_{CC}	2.5	2.8	3.6	V	**VCC**
Supply voltage for logic	V_{CCIO}	1.65	1.8	3.6	V	**IOVCC**
Input voltage	V_{IL}	0	-	$0.3V_{CCIO}$	V	
	V_{IH}	$0.7\ V_{CCIO}$	-	V_{CCIO}	V	

6.Timing Characteristics.

6.1 Reset Timing Characteristics.
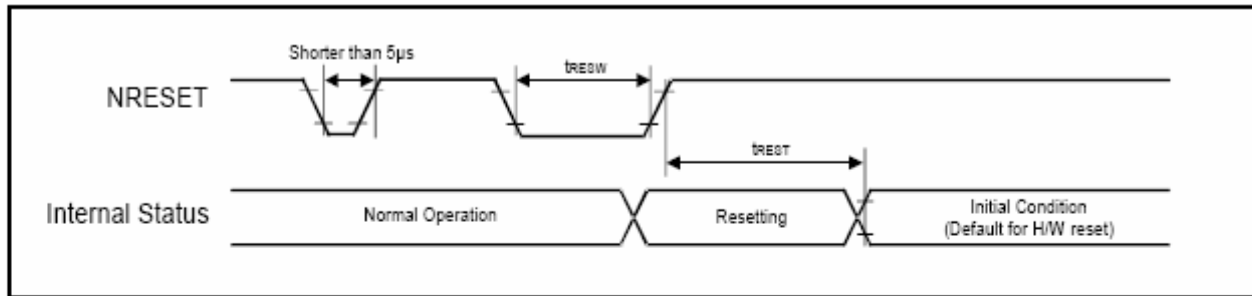
Figure 11. 6 Reset Input Timing

Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
t_{RESW}	Reset low pulse width[1]	NRESET	10	-	-	-	µs
t_{REST}	Reset complete time[2]	-	-	-	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:
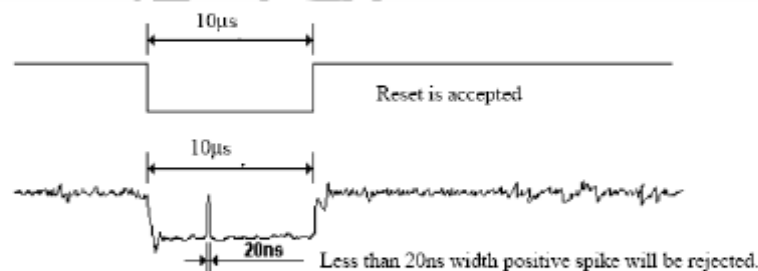
(5) It is necessary to wait 5msec after releasing RESET before sending commands. Also Sleep Out command cannot be sent for 120ms.

6.2. i80-System Interface Timing Characteristics.
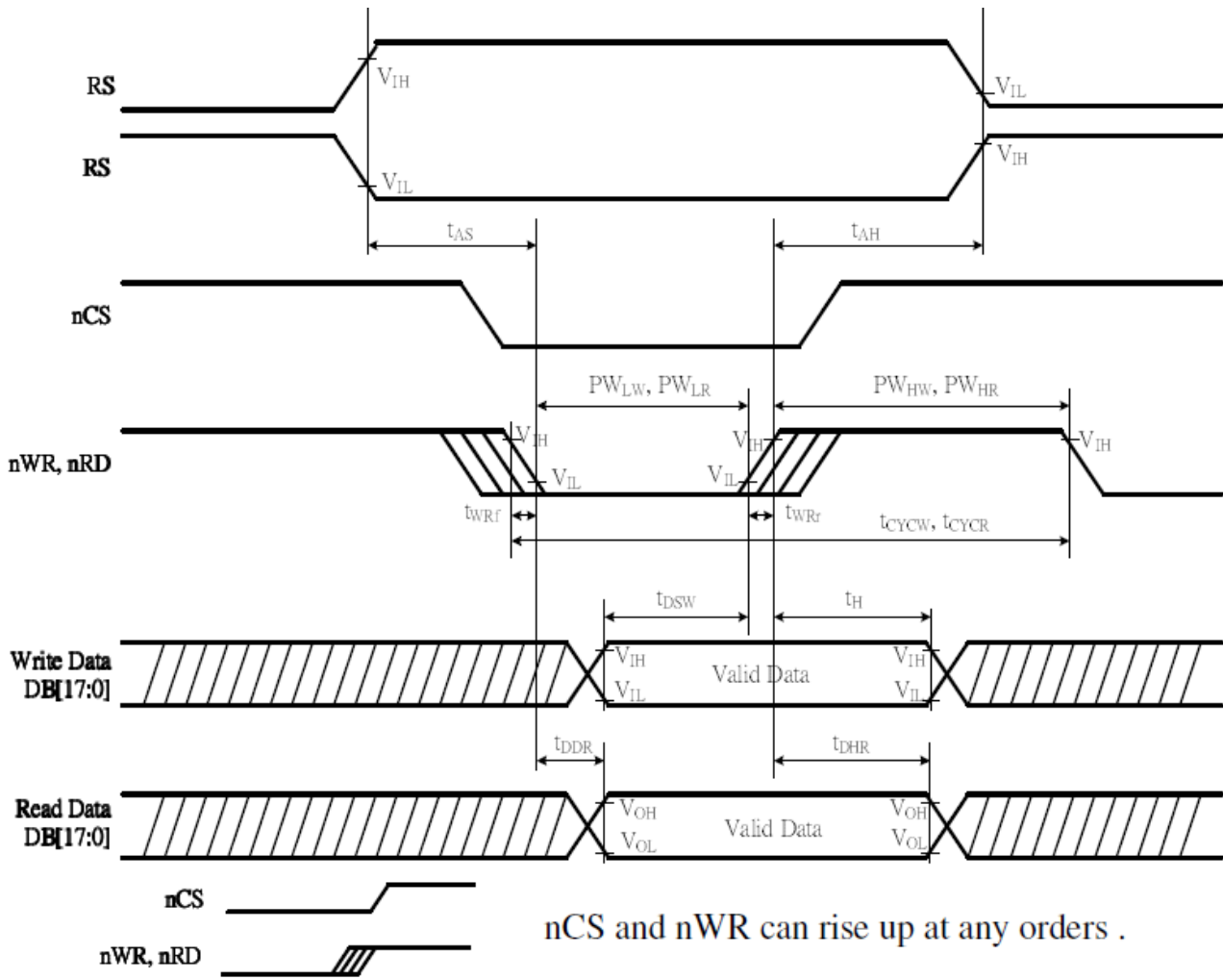
Normal Write Mode (IOVCC = 1.65~3.3V, VCI=2.5~3.3V)

Item		Symbol	Unit	Min.	Max.	Test Condition
Bus cycle time	Write	t_{CYCW}	ns	66	-	-
	Read	t_{CYCR}	ns	300	-	-
Write low-level pulse width		PW_{LW}	ns	35	500	-
Write high-level pulse width		PW_{HW}	ns	35	-	-
Read low-level pulse width		PW_{LR}	ns	150	-	-
Read high-level pulse width		PW_{HR}	ns	150	-	
Write / Read rise / fall time		t_{WRr}/t_{WRf}	ns	-	15	
Setup time	Write (RS to nCS, E/nWR)	t_{AS}	ns	10	-	
	Read (RS to nCS, RW/nRD)			5	-	
Address hold time		t_{AH}	ns	5	-	
Write data set up time		t_{DSW}	ns	10	-	
Write data hold time		t_H	ns	15	-	
Read data delay time		t_{DDR}	ns	-	100	
Read data hold time		t_{DHR}	ns	5	-	

7. Backlight Characteristics.
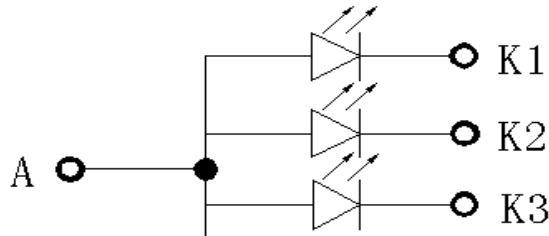
Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	3.0	3.2	3.4	V	If=45 mA	-
Supply Current	If	-	45	-	mA	-	-
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	144	-	mW	-	
Luminous Intensity for L CM		-	220	-	Cd/m²	If=45 mA	
Uniformity for LCM	-	80	-	-	%	If=45 mA	
Life Time	-	50000	-	-	Hr	If=45 mA	-
Backlight Color	White						

8.Optical Characteristics

Item		Symbol	Conditions	Specifications			Unit	Note
				Min.	Typ.	Max.		
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$	4.95	5.5	-	%	All left side data are based on CMI's following condition – 1.LC : TN 2.Light Source :CMI LED BLU 3.Film : 日東 NPF TEG 1465DU 4.Machine : DMS 803
Contrast Ratio		CR		-	300	-		
Response Time (by Quick)		T_{on}		-	10	-	ms	
		T_{off}		-	20	-	ms	
Viewing Angle	Hor.	θ_{X+}	Center CR>10	-	70	-	deg.	
		θ_{X-}		-	70	-		
	Ver.	θ_{Y+}		-	70	-		
		θ_{Y-}		-	55	-		
CF only Color Chromaticity (CIE 1931)	Red	X_R	Viewing normal angle $\theta_X = \theta_Y = 0°$	0.590	0.610	0.630		1.Under C light Simulation 2.NTSC 55%
		Y_R		0.309	0.329	0.349		
	Green	X_G		0.279	0.299	0.319		
		Y_G		0.547	0.567	0.587		
	Blue	X_B		0.123	0.143	0.163		
		Y_B		0.091	0.111	0.131)		
	White	X_W		0.288	0.308	0.328		
		Y_W		0.307	0.327	0.347		

*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):
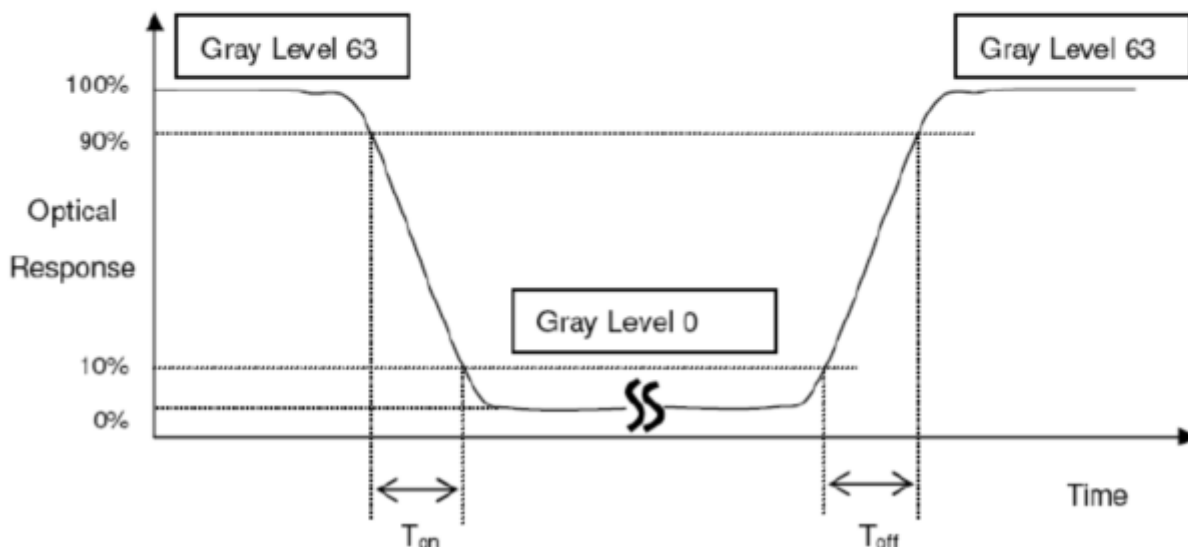
*Note(3)   Definition of Viewing Angle
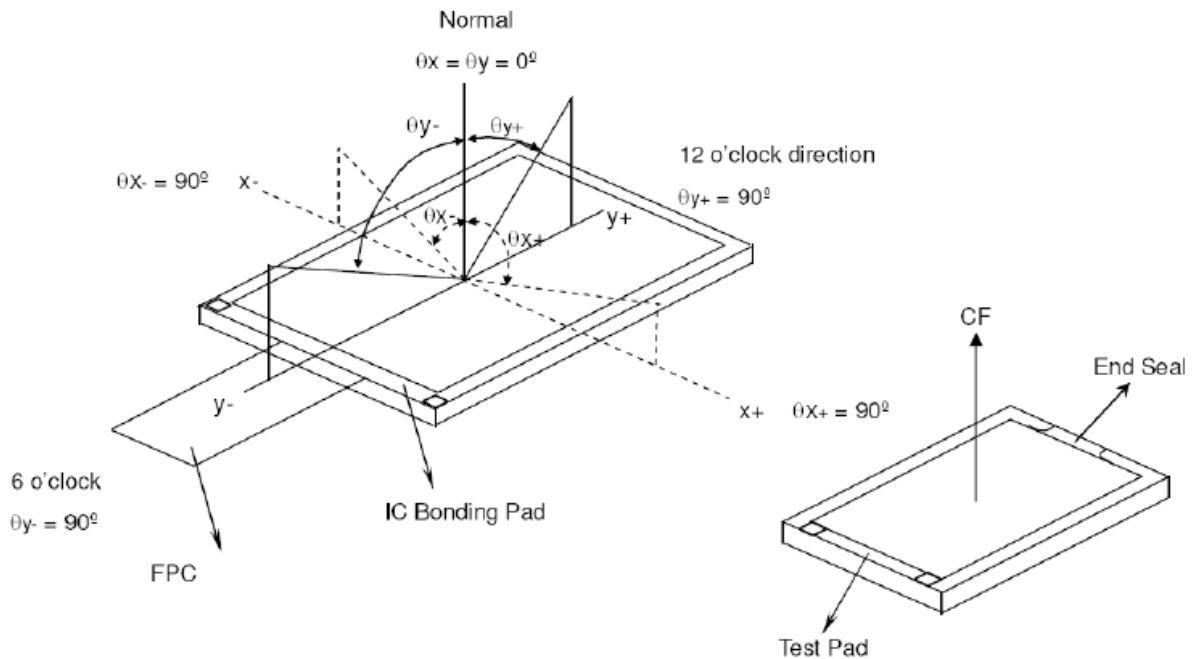
*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is 6 O'clock.   Module maker can increase the "Viewing Angle" by applying Wide View Film.

*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a 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.
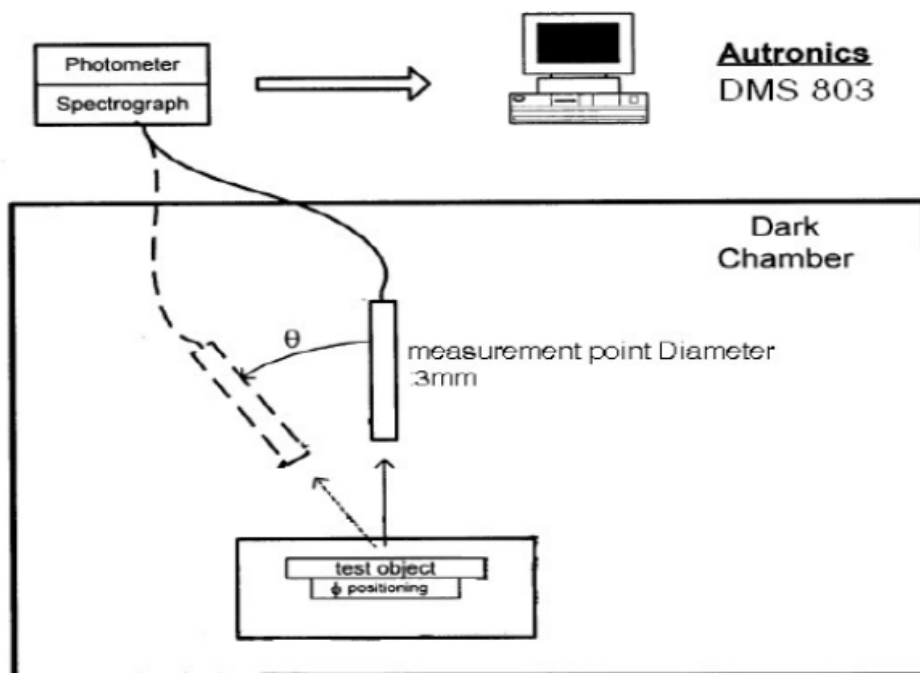
9. RELIABILITY

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
7	Shock resistance	D=25mm steel ball at 60cm height drops on the product surface for one time with no crack.	Note
8	Electronic Static Discharge	Air Discharge: 2KV to with 5 times	Discharge for each polarity Mode of Operation: Single Discharge, successive discharge at least 1 sec
		Ambiance: 15℃~35℃,30%~60%R.H Resistance(Rd): 330Ω ±10% Capacitance(Cs + Cd): 150pF±10%	
9	Vibration (Packaged)	Frequency range: 10Hz ~ 55 Hz Amplitude: 1.5mm Direction of X.Y. Z for 3 Hrs in total	
10	Drop Test (Packaged)	Height: 80cm, Time: 1 1 corner, 3 edged, 6 surfaces	

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±5° C.
　　10.4.3 Humidity: 50±20% RH.
　　　　　Illumination: 300 ~ 700 Lux.
　　10.4.4 Inspection Distance: 35±5 cm
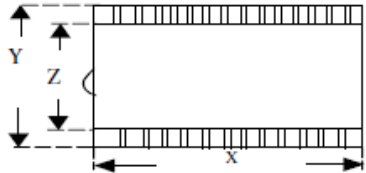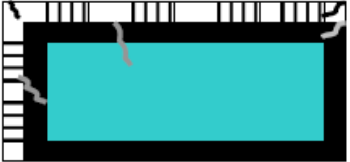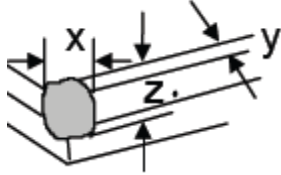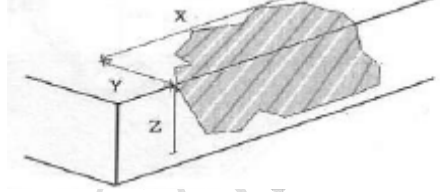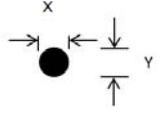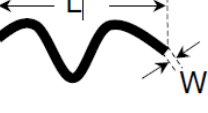
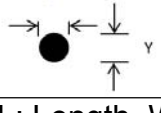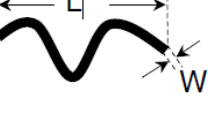## 10.5 TFT Inspection Criteria
　　10.5.1 Visual inspection criterion in cosmetic / appearance

Glass defect			
No	Item	Criteria	Remark
1	Dimension (Minor)	By engineering diagram	
2	Crack (Major)	Extensive crack	

3	Corner (Minor)	X ≤3 mm Y ≤3 mm Z≤ T Ignore	 T: Glass thickness Z: Thickness X: Length Y: Width
4	Side (Minor)	X ≤5mm Y ≤3 mm Z≤ T Ignore	 T: Glass thickness Z: Thickness X: Length Y: Width

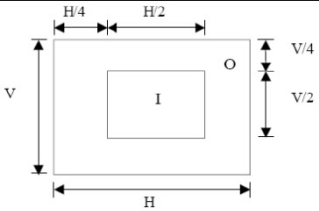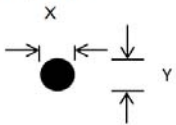| TFT defect in appearance			
No	Item	Criteria	Remark
1	Foreign Spot (Minor) Including: Black spot, White spot Pin hole Foreign particle	D≤0.15mm，Ignore 0.15mm<D≤0.3mm，N≤3 0.3mm<D，N=0 Distance≥5mm Ignore if out of Area AA	D =(X+Y)/2, X: Length, Y: Width D = (X+Y)/2 X Y
2	Foreign Line(Minor) Including: Black line White line Bright line	W≤0.03mm，Ignore 0.03mm<W≤0.05mm, L≤4mm, N≤3 0.05mm<W≤0.08mm, L≤4mm, N≤1 W>0.08mm, N=0 Ignore if out of Area AA	L: Length, W: Width L W
3	Polarizer Dent/Air Bubble (Minor)	D≤0.2mm，Ignore 0.2mm<D≤0.3mm，N≤3 0.3mm<D≤0.5mm，N≤1 D>0.50mm, N=0 Distance≥5mm	D =(X+Y)/2, X: Length, Y: Width D = (X+Y)/2 X Y
4	Polarizer Scratches (Minor)	W≤0.03mm，Ignore 0.03mm<W≤0.05mm, L≤4mm, N≤3 0.05mm<W≤0.08mm, L≤4mm, N≤1 W>0.08mm, N=0 Ignore if out of Area AA	L: Length, W: Width L W

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	Total	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≤0.15mm，Ignore 0.15mm<D≤0.3mm，N≤3 0.3mm<D≤0.35mm，N≤1 D>0.35mm, 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:
1.   Defect which is on the Black Matrix (outside of active area) are not considered as a defect.
2.   If any specific defect is not included in the above defect table, this defect should be judged by Formike.
3.   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± 10℃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℃±5℃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.