Specification for Approval

Customer:_____

Model Name:_____

Supplier Approval			Customer approval
R&D Designed	R&D Approved	QC Approved	
Peter	*Peng Jun*		

Revision Record

REV NO.	REV DATE	CONTENTS	Note
A	2016-04-27	NEW ISSUE	

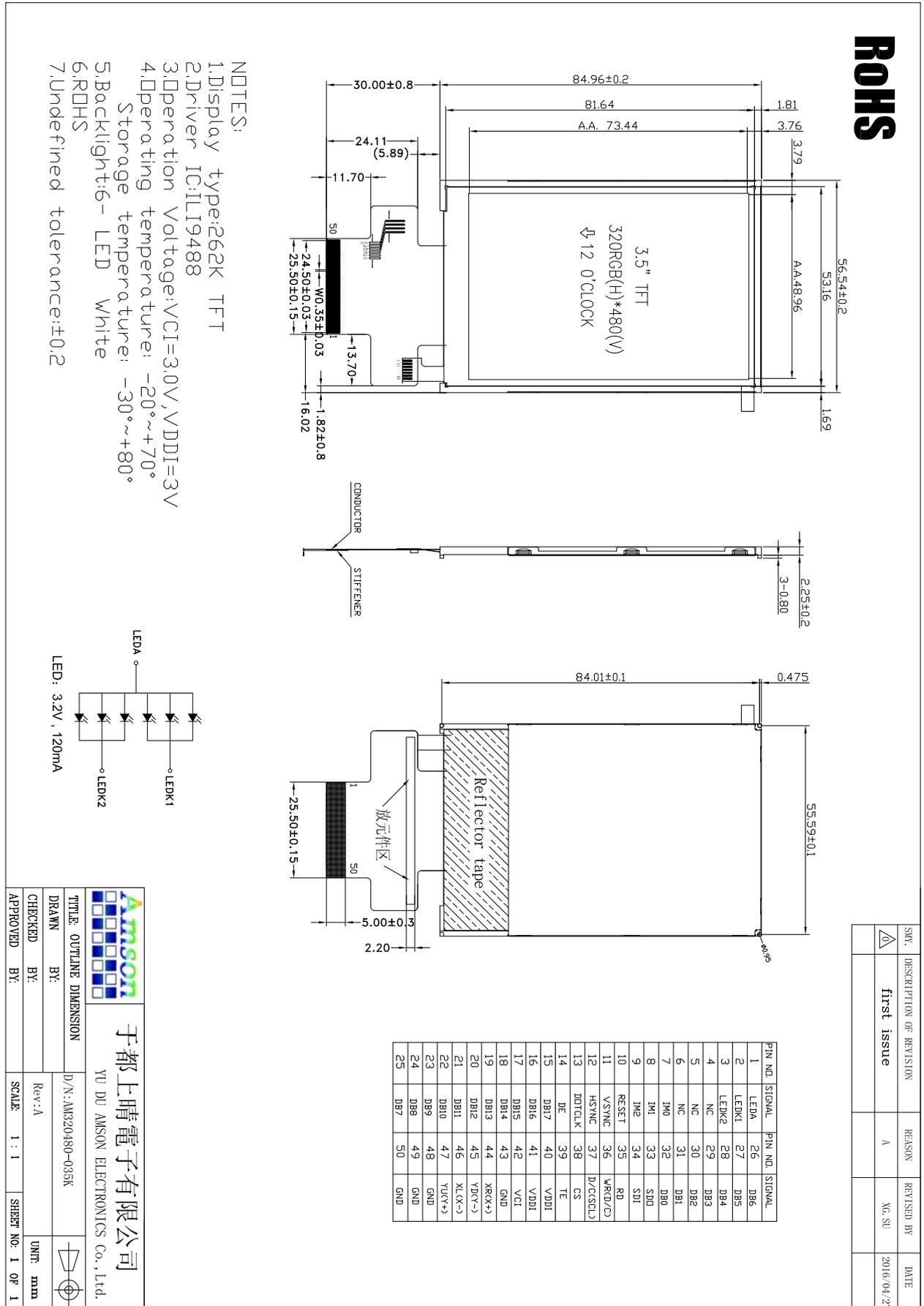# Table of Contents

1. Scope

This specification defines general provisions as well as inspection standards for TFT module supplied by AMSON electronics.

If the event of unforeseen problem or unspecified items may occur, naturally shall negotiate and agree to solution.

2. General Information

ITEM	STANDARD VALUES	UNITS
LCD type	3.5"TFT	--
Dot arrangement	320(RGB)×480	dots
Color filter array	RGB vertical stripe	--
Display mode	TN / Transmission / Normally White	-
Gray Scale Inversion Direction	12 O'clock	--
Eyes Viewing Direction	6 O'clock	--
Driver IC	ILI9488	--
Module size	56.54(W)×84.96(H)×2.25 (T)	mm
Active area	48.96(W)×73.44(H)	mm
Dot pitch	0.153(W)×0.153(H)	mm
Interface	4-lines_8bit / 3-lines_9bit SPI 8-/ 9-/16-/18-bit 8080-series system interface 16-/18-bit RGB interface	--
Operating temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C
Back Light	6 White LEDS	--
Weight	TBD	g

3. External Dimensions

NOTES:
1.Display type:262K TFT
2.Driver IC:ILI9488
3.Operation Voltage:VCI=3.0V,VDDI=3V
4.Operating temperature: -20°~+70°
    Storage temperature: -30°~+80°
5.Backlight:6-LED White
6.ROHS
7.Undefined tolerance:±0.2

3.5" TFT
320RGB(H)*480(V)
↑12 0'CLOCK

LED: 3.2V, 120mA

Reflector tape

PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	LEDA	26	DB6
2	LEDK1	27	DB5
3	LEDK2	28	DB4
4	NC	29	DB3
5	NC	30	DB2
6	NC	31	DB1
7	IM0	32	DB0
8	IM1	33	SDO
9	IM2	34	SDI
10	RESET	35	RD
11	VSYNC	36	WRD/C
12	HSYNC	37	D/CXSCL)
13	DOTCLK	38	CS
14	DE	39	TE
15	DB17	40	VDDI
16	DB16	41	VDDI
17	DB15	42	VCI
18	DB14	43	GND
19	DB13	44	XRCX+)
20	DB12	45	YD(Y+)
21	DB11	46	XL(X-)
22	DB10	47	YU(Y+)
23	DB9	48	GND
24	DB8	49	GND
25	DB7	50	GND

TITLE: OUTLINE DIMENSION
DRAWN BY:
CHECKED BY:
APPROVED BY:

Rev:A
D/N:AM320480-035K
YU DU AMSON ELECTRONICS Co., Ltd.

SCALE: 1:1
SHEET NO.1 OF 1
UNIT: mm

SYM.	DESCRIPTION OF REVISION	REASON	REVISED BY	DATE
	first issue	A	XG. SU	2016/04/27

4. Interface Description

PIN NO.	PIN NAME	DESCRIPTION				
1	LEDA	LED backlight (Anode).				
2	LEDK1	LED backlight (Cathode).				
3	LEDK2	LED backlight (Cathode).				
4	NC	No connecter				
5	NC	No connecter				
6	NC	No connecter				
7	IM0	System interface Mode				
		IM2	IM1	IM0	Interface mode	DB Pin
		0	0	0	i80-system 18-bit interface	DB[17:0]
8	IM1	0	0	1	i80-system 9-bit interface	DB[8:0]
		0	1	0	i80-system 16-bit interface	DB[15:0]
		0	1	1	i80-system 8-bit interface	DB[7:0]
9	IM2	1	0	1	3-wires_9-bit SPI	/CS,SDI,SDO,SCL
		1	1	1	4-wires_8-bit SPI	/CS,RS,SDI,SDO,SCL
10	/RESET	Reset input pin, Active "L".				
11	VSYNC	Vertical sync signal in RGB I/F.				
12	HSYNC	Horizontal sync signal in RGB I/F.				
13	DOTCLK	Pixel clock signal in RGB I/F.				
14	DE	Data enable signal in RGB I/F mode				

15-32	DB17-DB0	18-bit parallel bi-directional data bus for MPU system:
		  8-bit I/F: DB[7:0] is used.
		  9-bit I/F: DB[8:0] is used.
		  16-bit I/F: DB[15:0] is used.
		  24-bit I/F: DB[17:0] is used.
		
		18-bit input data bus for RGB I/F.
		  16-bit/pixel: DB[17:13]=R[4:0], DB[11:6]=G[5:0] and DB[5:1]=B[4:0];
		  18-bit/pixel: DB[17:12]=R[5:0], DB[11:6]=G[5:0] and DB[5:0]=B[5:0];
		Connect unused pins to GND.				

33	SDO	Serial output signal in SPI I/F.				
34	SDI	Serial input signal in SPI I/F.				
35	/RD	Reads strobe signal to write data when /RD is "Low" in MPU interface.				
36	/WR_SCL	MCU: Serves as a write signal and writes data at the rising edge. SPI: SCL pin as Serial Clock when operates in the serial interface.				
37	DCX	Display data / command selection in 80-series MPU I/F. DCX = "0" : Command DCX = "1" : Display data.				
38	/CS	Chip select input pin ("Low" enable) in MPU I/F and SPI I/F.				
39	TE	Tearing effect output pin to synchronize MPU to frame writing.				
40	IOVCC	I/O power supply.				
41	IOVCC	I/O power supply.				
42	VCI	System power supply.				
43	GND	Power ground				
44	XR	TP Right.				

45	YD	TP Bottom.
46	XL	TP Left.
47	YU	TP Up.
48	GND	Power ground
49	GND	Power ground
50	GND	Power ground

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Logic Supply Voltage	IOVCC	-0.3	3.3	V
Analog Supply Voltage	VCC	-0.3	3.3	V
Input Voltage	Vin	-0.3	IOVCC+0.3	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{ST}	-30	80	°C
Storage Humidity	HD	20	90	%RH

6. DC Characteristics

| Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Logic Supply Voltage	IOVCC	1.65	1.8/2.8	3.3	V	-
Analog Supply Voltage	VCC	2.5	2.8	3.3	V	-
Input High Voltage	V_{IH}	0.7IOVCC	-	IOVCC	V	-
Input Low Voltage	V_{IL}	GND	-	0.3IOVCC	V	-
Output High Voltage	V_{OH}	0.8IOVCC	-	IOVCC	V	-
Output Low Voltage	V_{OL}	GND	-	0.2IOVCC	V	-
I/O Leak Current	I_{LI}	-1.0	-	1.0	uA	-

7. Timing Characteristics
7.1 i80-System Interface Timing Characteristics
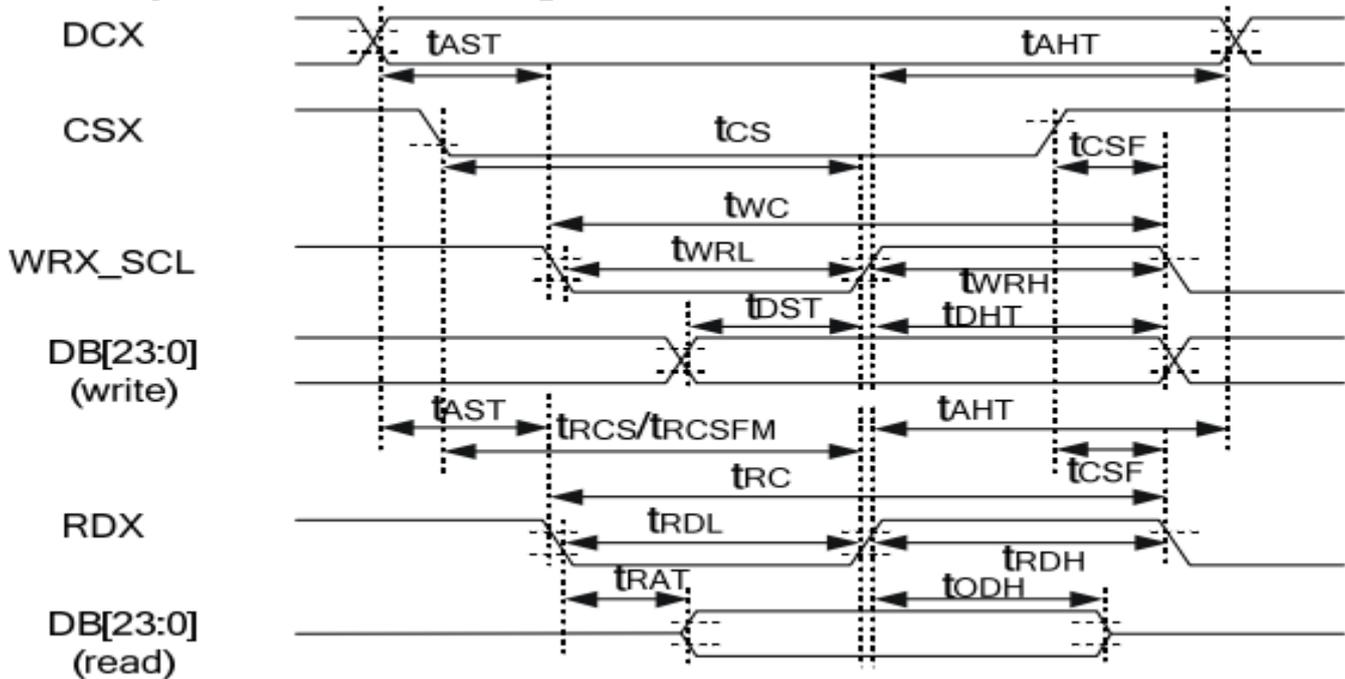
Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX	t_{AST}	Address setup time	0	-	ns	-
	I	Address hold time (Write/Read)	10	-		
CSX	t_{CS}	Chip select setup time (Write)	10	-	ns	-
	t_{RCS}	Chip select setup time (Read register)	45	-		
	t_{RCSFM}	Chip select setup time (GRAM)	355	-		
	t_{CSF}	Chip select wait time (Write/Read)	10	-		
WRX_SCL	t_{WC}	Write cycle (write register)	50	-	ns	-
	t_{WC}	Write cycle (write GRAM@SLPOUT)	47	-		
	t_{WC}	Write cycle (write GRAM@SLPIN)	100	-		
	t_{WRH}	Control pulse "H" duration	15	-		
	t_{WRL}	Control pulse "L" duration	15	-		
RDX	t_{RC}	Read cycle (read register)	160	-	ns	-
	t_{RC}	Read cycle (GRAM)	450	-		
	t_{RDH}	Control pulse "H" duration	90	-		
	t_{RDL}	Control pulse "L" duration(read register)	35	-		
	t_{RDL}	Control pulse "L" duration(GRAM)	345	-		
DB[23:0]	t_{DST}	Data setup time	10	-	ns	For maximum C_L=30pF For minimum C_L=8pF
	t_{DHT}	Data hold time	10	-		
	t_{RAT}	Read access time(read register)	-	40		
	t_{RAT}	Read access time(GRAM)	-	340		
	t_{ODH}	Output disable time	20	80		

7.2 Display Serial Interface Timing Characteristics (SPI system)
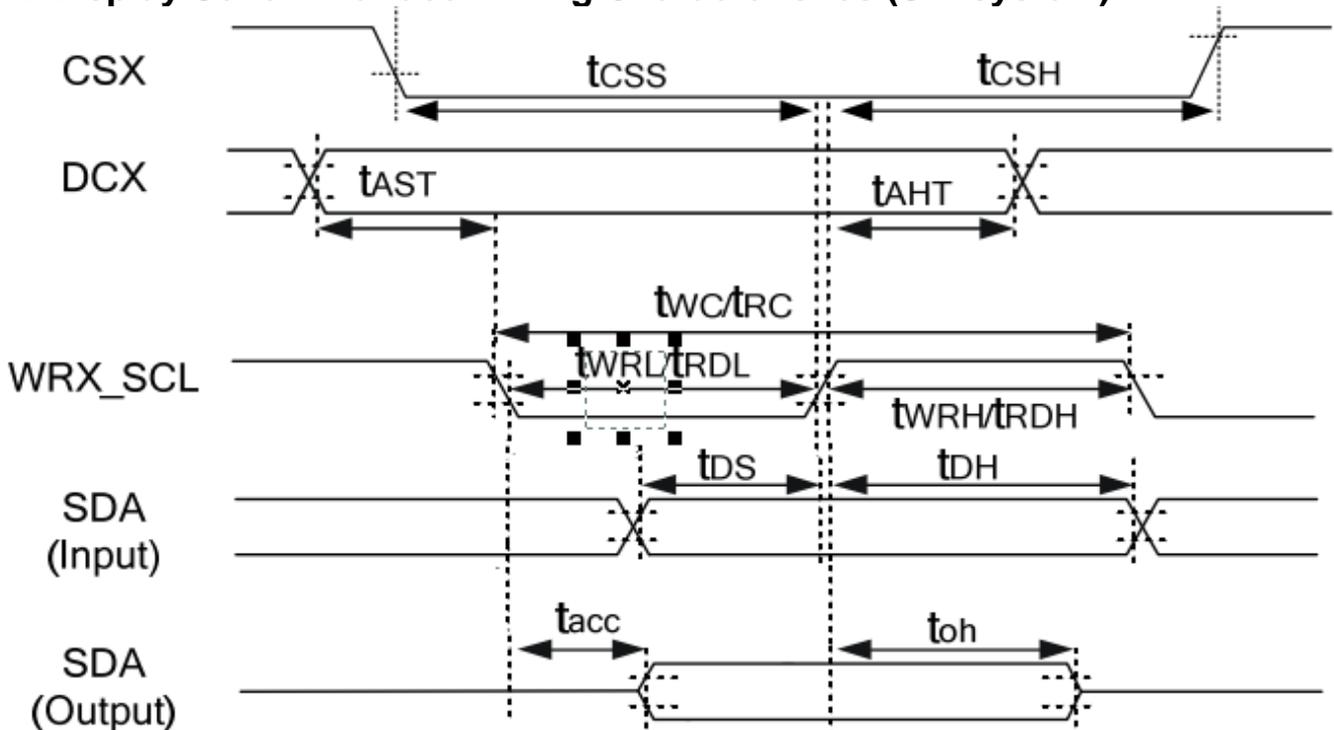
Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	t_{CSS}	Chip select setup time (Write)	15	-	ns	-
	t_{CSS}	Chip select setup time (Read)	60	-		
	t_{CSH}	Chip select hold time (Write)	15	-		
	t_{CSH}	Chip select hold time (Read)	65	-		
DCX	t_{AST}	Address setup time	0	-	ns	-
	I	Address hold time (Write/Read)	10	-		
WRX_SCL (Write)	t_{WC}	Write cycle	66	-	ns	-
	t_{WRH}	Control pulse "H" duration	15	-		
	t_{WRL}	Control pulse "L" duration	15	-		
WRX_SCL (Read)	t_{RC}	Read cycle	150	-	ns	-
	t_{RDH}	Control pulse "H" duration	60	-		
	t_{RDL}	Control pulse "L" duration	60	-		
SDA (Input)	t_{DS}	Data setup time	10	-	ns	For maximum C_L=30pF
	t_{DH}	Data hold time	10	-		For minimum C_L=8pF
SDA (Output)	t_{ACC}	Read access time	10	50	ns	
	t_{OH}	Output disable time	15	50		

7.3 Parallel 18-bit RGB Interface Timing Characteristics
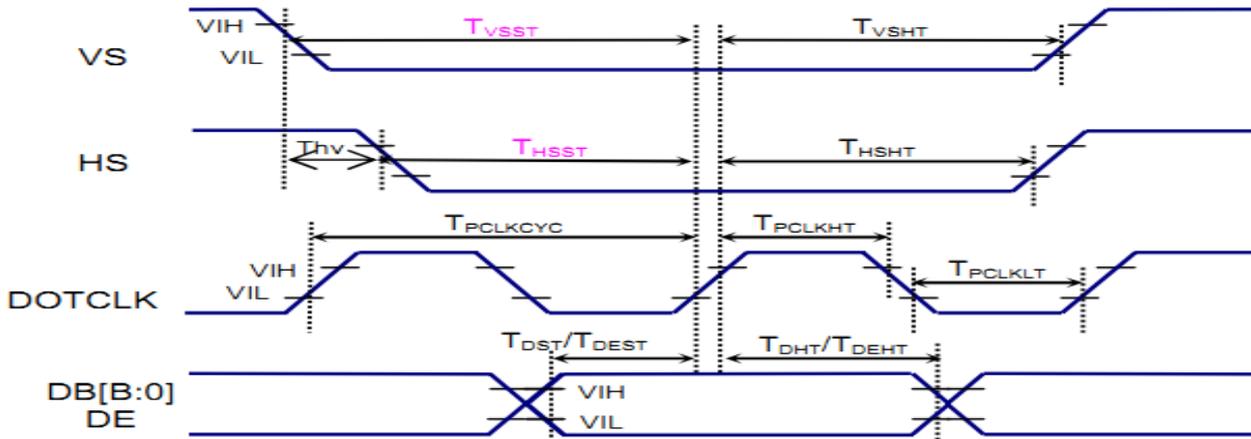
Item	Symbol	Condition	Spec. Min.	Spec. Typ.	Spec. Max.	Unit
Pixel low pulse width	T_{CLKLT}	-	15	-	-	ns
Pixel high pulse width	T_{CLKHT}	-	15	-	-	ns
Vertical Sync. Set-up time	T_{VSST}	-	15	-	-	ns
Vertical Sync. Hold time	T_{VSHT}	-	15	-	-	ns
Horizontal Sync. Set-up time	T_{HSST}	-	15	-	-	ns
Horizontal Sync. Hold time	T_{HSHT}	-	15	-	-	ns
Data Enable set-up time	T_{DEST}	-	15	-	-	ns
Data Enable hold time	T_{DEHT}	-	15	-	-	ns
Data set-up time	T_{DST}	-	15	-	-	ns
Data hold time	T_{DHT}	-	15	-	-	ns
Phase difference of sync signal falling edge	Thv	-	0	-	320	Dotclk

Vertical Timing for RGB I/F
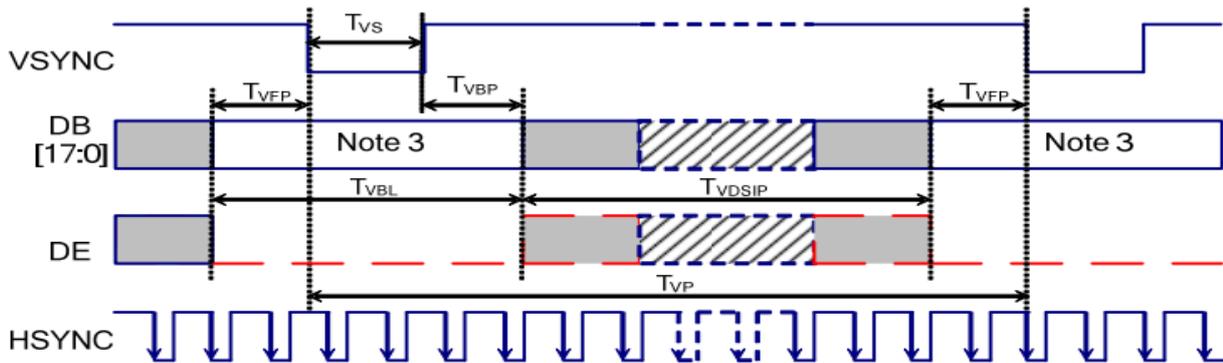
Horizontal Timing for RGB I/F
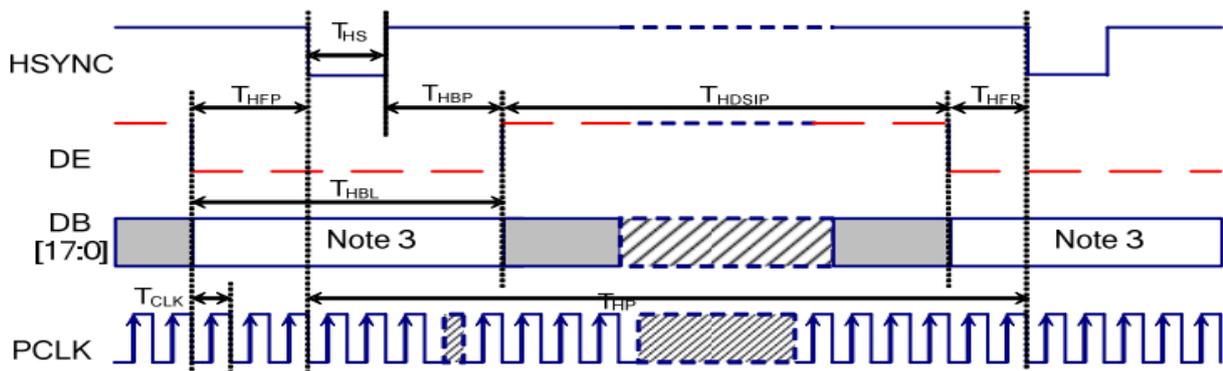
Item	Symbol	Condition	Specification			Unit
			Min.	Typ.	Max.	
Vertical Timing						
	VP	-	486	-	-	HS
Vertical low pulse width	T_{VS}					
Vertical front porch	T_{VFP}	-	2	-	-	HS
Vertical back porch	T_{VBP}	-	2	-	-	HS
Vertical blanking period	T_{VBL}	$T_{VS} + T_{VBP} + T_{VFP}$	6	-	-	HS
Vertical active area	T_{VDISP}	-	-	-	-	HS
			-	480	-	HS
			-	-	-	HS
Vertical refresh rate	T_{VRR}	Frame rate	50	60	70	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}	-	335	-	-	DOTCLK
Horizontal low pulse width	T_{HS}	-	5	-	-	DOTCLK
Horizontal front porch	T_{HFP}	-	5	-	-	DOTCLK
Horizontal back porch	T_{HBP}	-	5	-	-	DOTCLK
Horizontal blanking period	T_{HBL}	$T_{HS} + T_{HBP} + T_{HFP}$	15	-	-	DOTCLK
Horizontal active area	T_{HDISP}	-	-	320	-	DOTCLK
Pixel clock cycle TVRR=60Hz	f_{CLKCYC}	-	9	-	-	MHz

Note: (1) IOVCC=1.65 to 3.3V, VCI=2.3 to 3.3V, VSSA=VSSD=0V, Ta=-30 to 70℃ (to +85℃ no damage)

(2) Data lines can be set to "High" or "Low" during blanking time – Don't care.

(3) HP is multiples of PCLK.

7.4 Reset Timing Characteristics
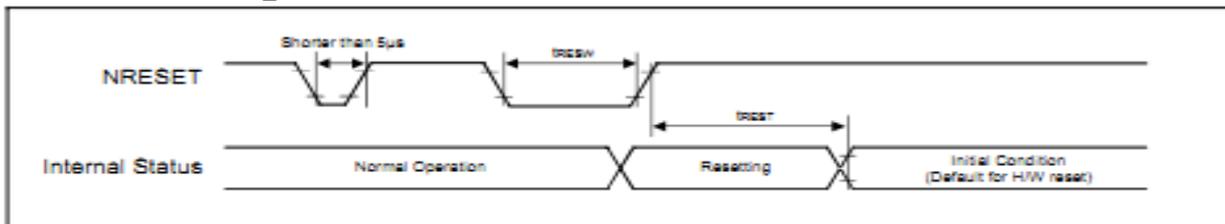
Figure 8.4: Reset input timing

Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width[1]	NRESET	10	-	-	-	μs
tREST	Reset complete time[2]	-	-	5	-	When reset applied during SLPIN mode	ms
		-	-	120	-	When reset applied during SLPOUT mode	ms

Table 8.7: Reset input timing

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

NRESET Pulse	Action
Shorter than 5 μs	Reset Rejected
Longer than 10 μs	Reset
Between 5 μs and 10 μs	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, ID and VCOM 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 NRESET.

(4) Spike Rejection also applies during a valid reset pulse as shown as below:
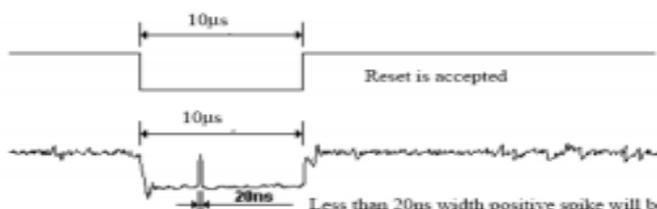
01. It is necessary to wait 5msec after releasing NRESET before sending commands. Also Sleep Out command cannot be sent for 120msec.

8.

Backlight Characteristics
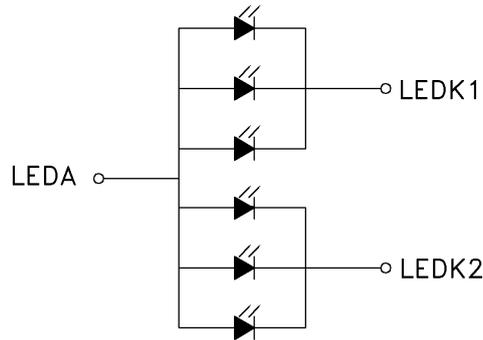
LED：3.2V , 120mA

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	2.8	3.2	3.4	V	If=120mA
Supply Current	If	-	120	-	mA	-
Luminous Intensity for LCM	-	300	400	-	cd/m^2	If=120mA
Uniformity for LCM	-	80	-	-	％	If=120mA
Life Time	-	20000	-	-	Hr	If=120mA
Backlight Color	White					

9. Optical Characteristics

Item	Conditions		Min.	Typ.	Max.	Unit	Note
Viewing Angle (CR>10)	Horizontal	θL	60	70	-	degree	(1),(2),(6)
		θR	60	70	-		
	Vertical	θT	60	70	-		
		θB	40	60	-		
Contrast Ratio	Center		400	500	-	-	(1),(3),(6)
Response Time	Rising		-	(4)	(8)	ms	(1),(4),(6)
	Falling			(12)	(24)		
CF Color Chromaticity (CIE1931)	Red x		Typ. -0.05	0.626	Typ. +0.05	-	(1), (6)
	Red y			0.334		-	
	Green x			0.277		-	
	Green y			0.549		-	
	Blue x			0.142		-	
	Blue y			0.122		-	
	White x			0.303		-	
	White y			0.325		-	

Note (1) Measurement Setup: The LCD module should be stabilized at given temp. 25°C for 15 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 15 minutes in a windless room.
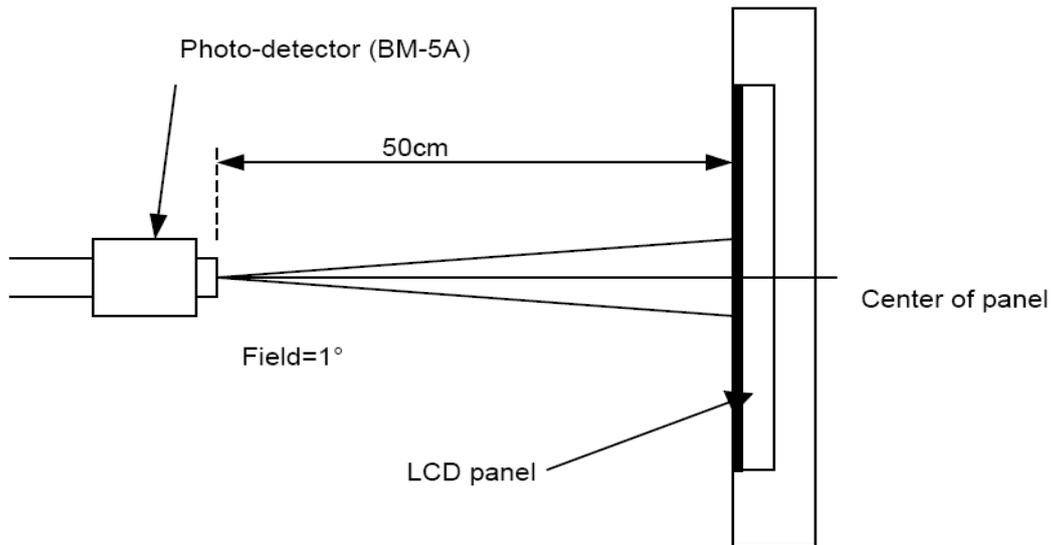
Note (2) Definition of Viewing Angle
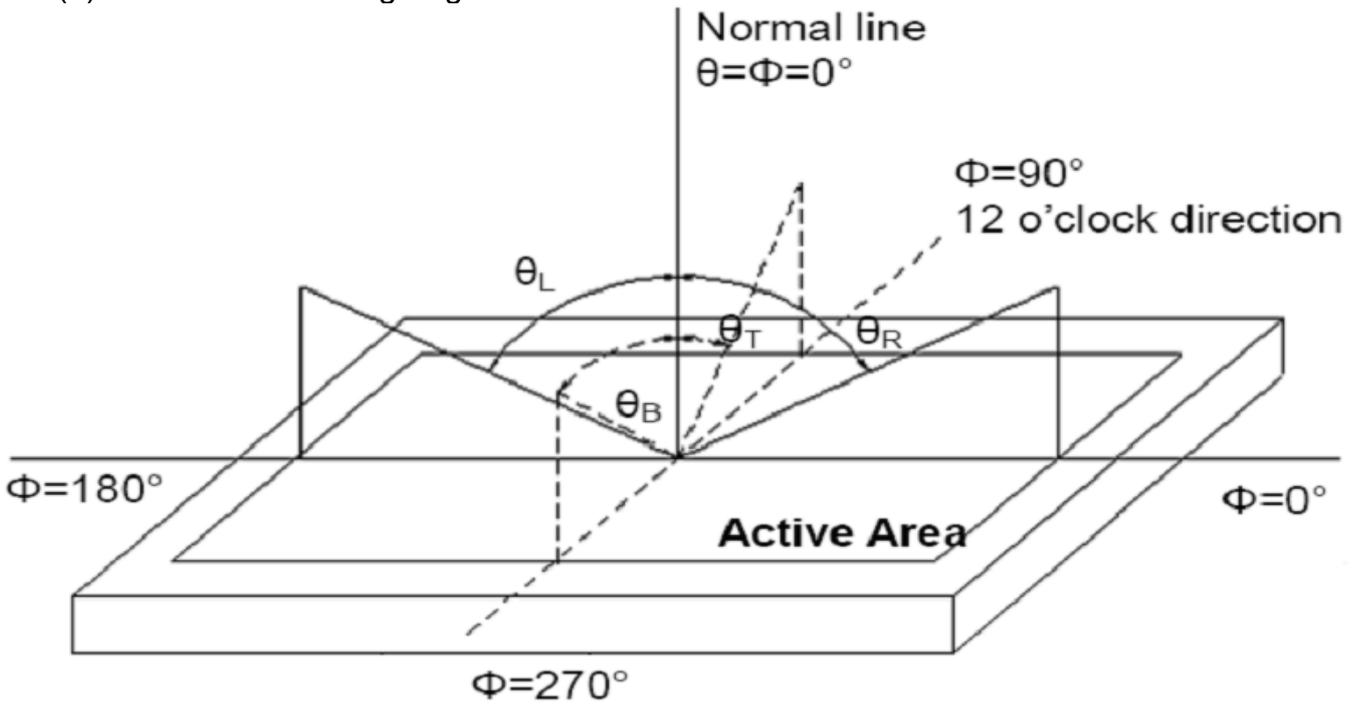
Note (3) Definition of Contrast Ratio (CR)
　　　The contrast ratio can be calculated by the following expression
　　　Contrast Ratio (CR) = L63 / L0
　　　L63: Luminance of gray level 63, L0: Luminance of gray level 0

Note (4) Definition of response time
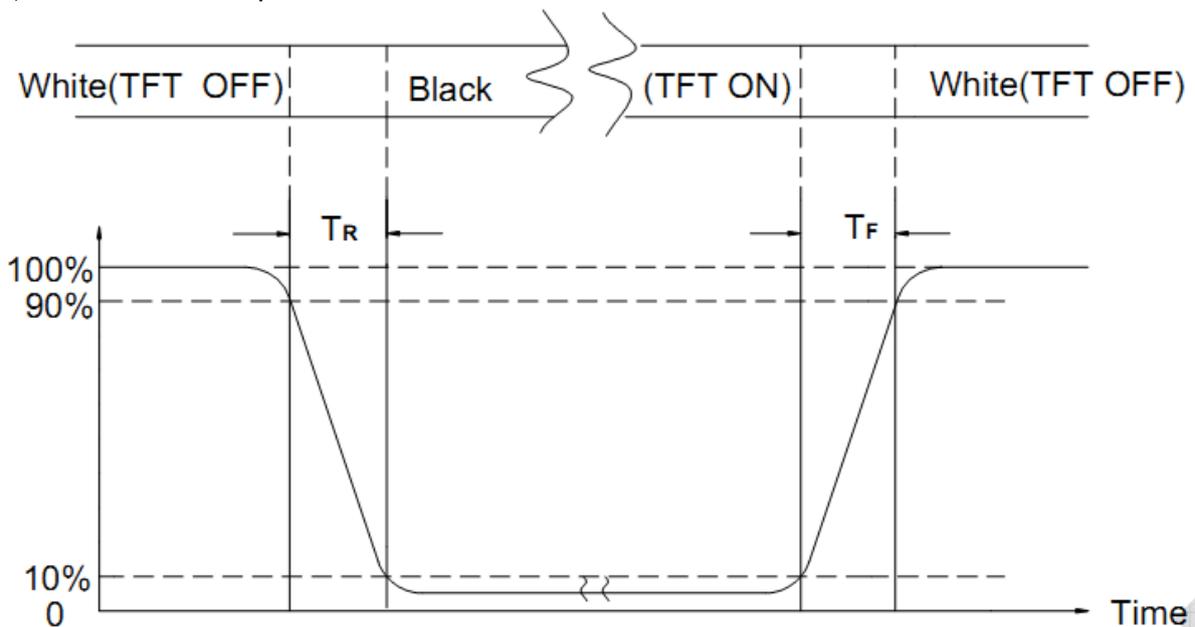
Note (5) Definition of Transmittance (Module is without signal input)
　　　Transmittance = Center Luminance of LCD / Center Luminance of Back Light x 100%

Note (6) Definition of color chromaticity (CIE1931)

　　　Color coordinates measured at the center point of LCD

10. Reliability Test Conditions and Methods

No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: 20±5°C   Humidity: 65±5%RH

Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state)	--
2	Low Temperature Operating	-20°C±2°C, 240hrs (Operation state)	--
3	High Temperature Storage	80°C±2°C, 240hrs	--
4	Low Temperature Storage	-30°C±2°C, 240hrs	--
5	High Temperature and High Humidity Operation Test	60°C±2°C, 90%, 240hrs	--
6	Vibration Test	Total fixed amplitude: 1.5mm Vibration Frequency: 10~55Hz One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	--

7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.
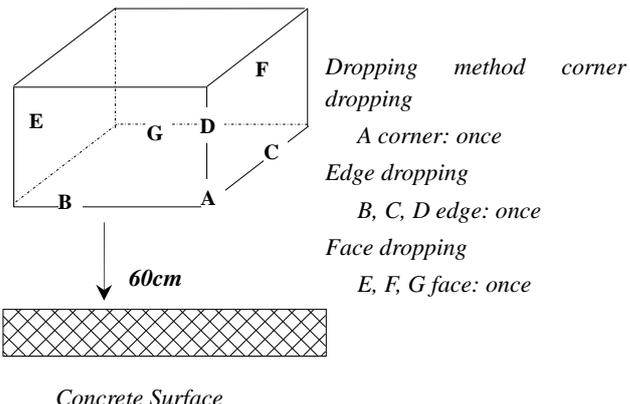		
		Dropping method corner dropping
		  A corner: once
		Edge dropping
		  B, C, D edge: once
		Face dropping
		  E, F, G face: once
		60cm
		Concrete Surface
			--

Notes: 1. No dew condensation to be observed.

2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

3. Vibration test will be conducted to the product itself without putting I in a container.

11. Inspection Standard

11.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

Temperature: 25±5℃

Humidity:　65%±10%RH

Viewing Angle: Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm
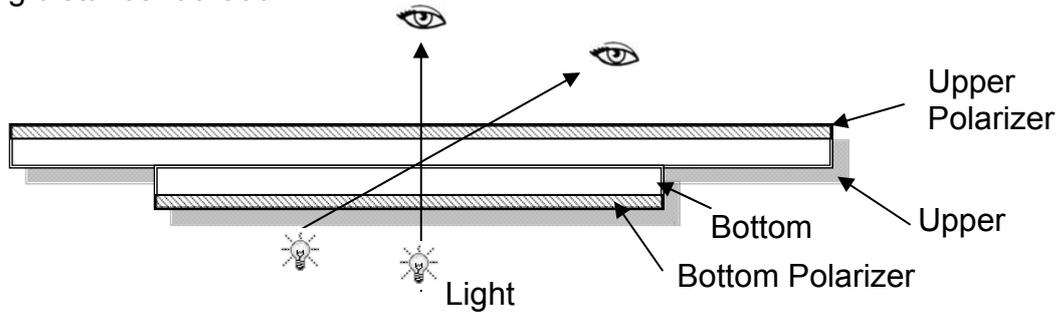
11.1.2 Definition
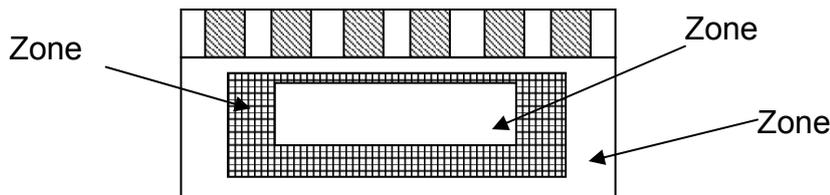
Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) which cannot be seen after assembly by customer.)

Note:

　　　As a general rule, visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

11.1.3 Sampling Plan

According to GB/T 2828-2003; normal inspection, Class Ⅱ

AQL:

Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	

4	Color tone	Color unevenness, refer to limited sample	
5	Soldering appearance	Good soldering, Peeling off is not allowed.	Minor
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

11.1.4 Criteria (Visual)

Number	Items	Criteria(mm)
1.0 LCD Crack / Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 | X	Y	Z | |---|---|---| | ≤3.0mm | <Inner border line of the seal | ≤T |
	(2)LCD corner broken	 | X	Y	Z | |---|---|---| | ≤3.0mm | ≤L | ≤T |
	(3) LCD crack	 Crack Not allowed
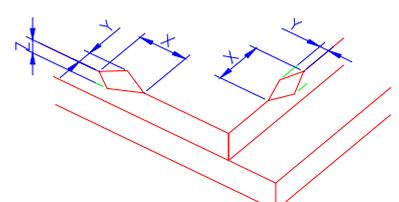
Number	Items	Criteria (mm)		
2.0	Spot defect Φ=(X+Y)/2	① light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）		

① light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）

Zone \ Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.10	Ignore		Ignore
0.10<Φ≤0.15	3(distance≥10mm)		
0.15<Φ≤0.2	1		
0.2<Φ	0		

②Dim spot（LCD/TP/Polarizer dim dot, light leakage、dark spot）

Zone \ Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.1	Ignore		Ignore
0.1<Φ≤0.2	2(distance≥10mm)		
0.2<Φ≤0.3	1		
Φ＞0.3	0		

③ Polarizer accidented spot

Zone \ Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.5	2(distance≥10mm)		
Φ>0.5	0		

Line defect (LCD/TP /Polarizer black/white line, scratch, stain)

Width(mm)	Length(mm)	Acceptable Qty		
		A	B	C
Φ≤0.03	Ignore	Ignore		Ignore
0.03<W≤0.05	L≤3.0	N≤2		
0.05<W≤0.08	L≤2.0	N≤2		
0.08<W	Define as spot defect			

3.0	Polarizer Bubble	Size (mm) \ Zone	Acceptable Qty		
			A	B	C
		Φ≤0.2	Ignore		Ignore
		0.2<Φ≤0.4	2(distance≧10mm)		
		0.4<Φ≤0.6	1		
		0.6<Φ	0		
4.0	SMT	According to IPC-A-610C class Ⅱ standard. Function defect and missing part are major defect, the others are minor defect.			

12. Handling Precautions

12.1 Mounting method

The LCD panel of AMSON TFT 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.

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 happen 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 use C-MOS LSI drivers, so we recommended that you:

Connect any unused input terminal to power or ground, do not input any signals before power is turned on, and ground your body, work/assembly areas, and 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 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.
- 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 storing

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 AMSON TFT , 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.

14. Packing Method
TBD