

Specification for Approval

Customer: _____

Model Name: _____

Supplier Approval			Customer approval
R&D Designed	R&D Approved	QC Approved	
<i>Peter</i>	<i>Peng Jun</i>		

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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	2.4" TFT	--
Dot arrangement	240(RGB)×320	dots
Color filter array	RGB vertical stripe	--
Display mode	TN / Transmissive / Normally White	--
Viewing Direction	12 o'clock(Gray scale inversion)	--
Driver IC	ILI9341	--
Module size	42.72(W)×60.26(H)×3.5(T)	mm
Active area	36.72(W)×48.96(H)	mm
Dot pitch	0.153 (W)×0.153 (H)	mm
Interface	i80-system 8/16-bit interface	--
Operating temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C
Back Light	4 White LED In Parallel	--
Weight	TBD	g

4. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	IM0	IM0=0: 16bit, use DB0-DB15. IM0=1: 8bit, use DB8-DB15.
2	XL	Touch Left.
3	YU	Touch Up.
4	XR	Touch Right.
5	YD	Touch Bottom.
6	GND	Power ground.
7	IOVCC	System power supply.
8	VCI	System power supply.
9	TE	Tearing effect output pin to synchronize MPU to frame writing, activated by S/W command.
10	CSX	Chip select signal input terminal, Active at 'L'.
11	D/CX	Register select signal input terminal: D/CX='H': select a control register; D/CX='L': select an index or status register.
12	WRX	Write signal input terminal, Active at 'L'.
13	RDX	Read signal input terminal, Active at 'L'.
14	DB0	DATA BUS: 8-bit I/F: DB [15:8] is used. 16-bit I/F: DB [15:0] is used. Unused pins must be fixed to GND level.
15	DB1	
16	DB2	
17	DB3	
18	DB4	
19	DB5	
20	DB6	
21	DB7	
22	DB8	
23	DB9	
24	DB10	
25	DB11	
26	DB12	
27	DB13	
28	DB14	
29	DB15	
30	RESX	Reset signal input terminal, active at 'L'.
31	NC	No Connection.
32	LEDA	LED backlight anode.
33	LEDK1	LED backlight cathode.
34	LEDK2	LED backlight cathode.
35	LEDK3	LED backlight cathode.
36	LEDK4	LED backlight cathode.
37	NC	No Connection.
38~40	GND	Power ground.

5. Absolute Maximum Ratings

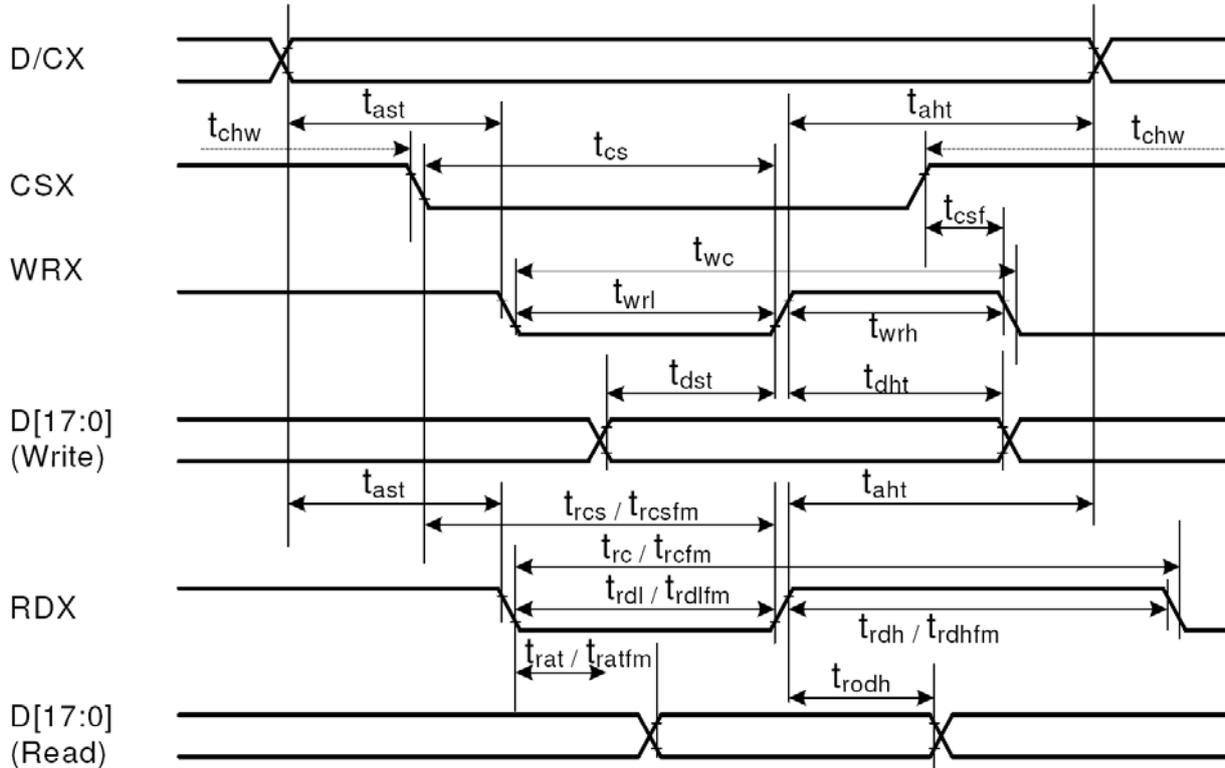
Item	Symbol	Min.	Max.	Unit
Logic Supply Voltage	IOVCC	-0.3	4.6	V
Analog Supply Voltage	VCI	-0.3	4.6	V
Input Voltage	V _{in}	-0.3	IOVCC+0.3	V
Operating Temperature	T _{OP}	-20	70	°C
Storage Temperature	T _{ST}	-30	80	°C
Storage Humidity	HD	20	90	%RH

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	VCI	2.5	2.8	3.3	V	--
Input High Voltage	V _{IH}	0.7IOVCC	--	IOVCC	V	Digital input pins
Input Low Voltage	V _{IL}	GND	--	0.3IOVCC	V	Digital input pins
Output High Voltage	V _{OH}	0.8IOVCC	--	IOVCC	V	Digital output pins
Output Low Voltage	V _{OL}	GND	--	0.2IOVCC	V	Digital output pins
I/O Leak Current	I _{LI}	-0.1	--	0.1	uA	--

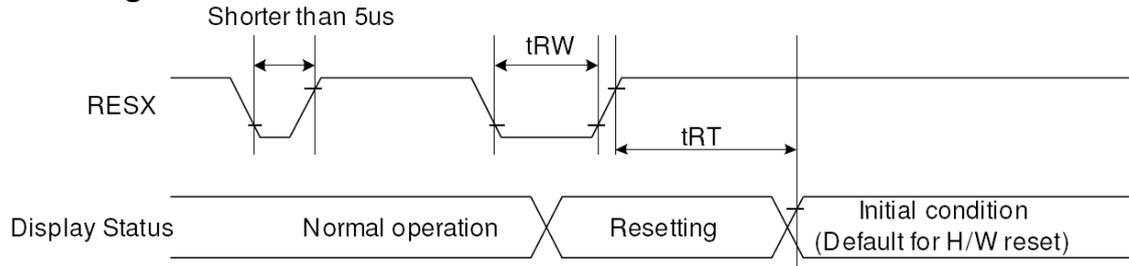
7. Timing Characteristics

7.1 i80-System Interface Timing Characteristics



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t _{ast}	Address setup time	0	-	ns	
	t _{ah}	Address hold time (Write/Read)	0	-	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	
WRX	t _{csf}	Chip Select Wait time (Write/Read)	10	-	ns	
	t _{wc}	Write cycle	66	-	ns	
	t _{wrh}	Write Control pulse H duration	15	-	ns	
RDX (FM)	t _{wrl}	Write Control pulse L duration	15	-	ns	
	t _{rcfm}	Read Cycle (FM)	450	-	ns	
	t _{rdhfm}	Read Control H duration (FM)	90	-	ns	
RDX (ID)	t _{rdlfm}	Read Control L duration (FM)	355	-	ns	
	t _{rc}	Read cycle (ID)	160	-	ns	
	t _{rdh}	Read Control pulse H duration	90	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	t _{rdl}	Read Control pulse L duration	45	-	ns	
	t _{dst}	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	t _{dht}	Write data hold time	10	-	ns	
	t _{rat}	Read access time	-	40	ns	
	t _{ratfm}	Read access time	-	340	ns	
t _{rodh}	Read output disable time	20	80	ns		

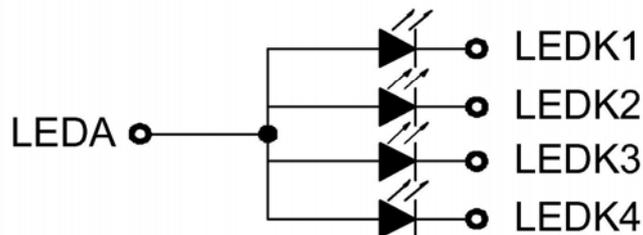
7.2 Reset Timing Characteristics



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1.6,7)	mS

8. Backlight Characteristic

LED Circuit:



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	3.0	3.2	3.5	V	If=60mA
Supply Current	If	--	60	80	mA	--
Luminous Intensity for LCM	--	170	200	--	Cd/m ²	If=60mA
Uniformity for LCM	--	80	--	--	%	If=60mA
Life Time	--	20000	--	--	Hr	If=60mA
Backlight Color		White				

9. Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)	T(%)	—	—	(14.4)	—	—	
Contrast Ratio	CR	$\Theta=0$	400	500	—	—	(1)(2)
Response time	Rising	T_R	—	4	8	msec	(1)(3)
	Falling	T_F	—	12	24		
Color gamut		S(%)		60		%	
Color chromaticity (CIE1931)	White	W_x	0.283	0.303	0.323		(1)(4) CF glass (C-light)
		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	—	

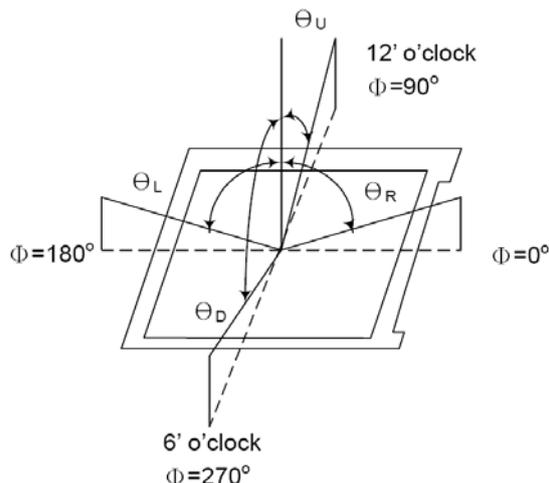
Measuring Condition:

Dark room, $25\pm 2^\circ\text{C}$, 15min. warm-up time.

Measuring Equipment

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

Note (1) Definition of Viewing Angle :

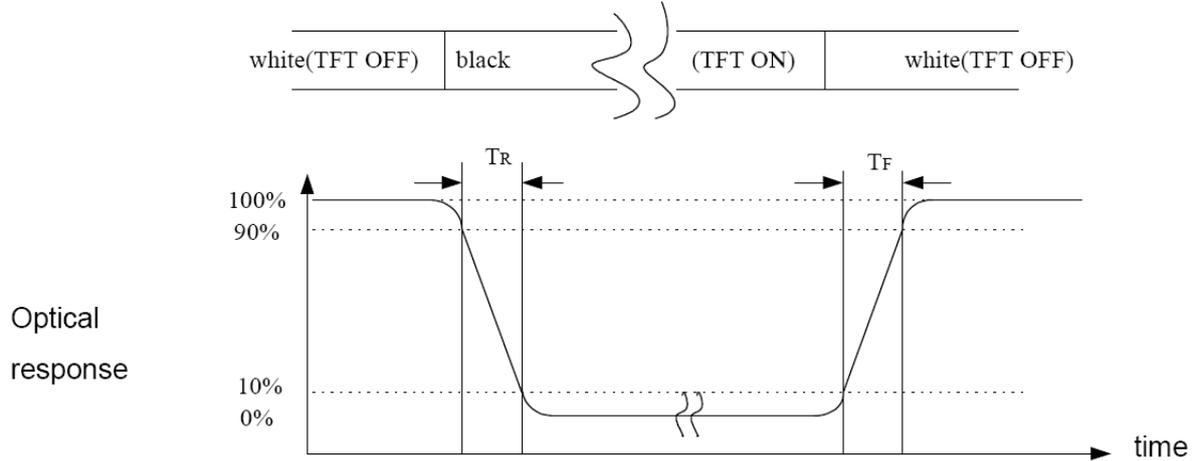


Note (2) Definition of Contrast Ratio (CR):

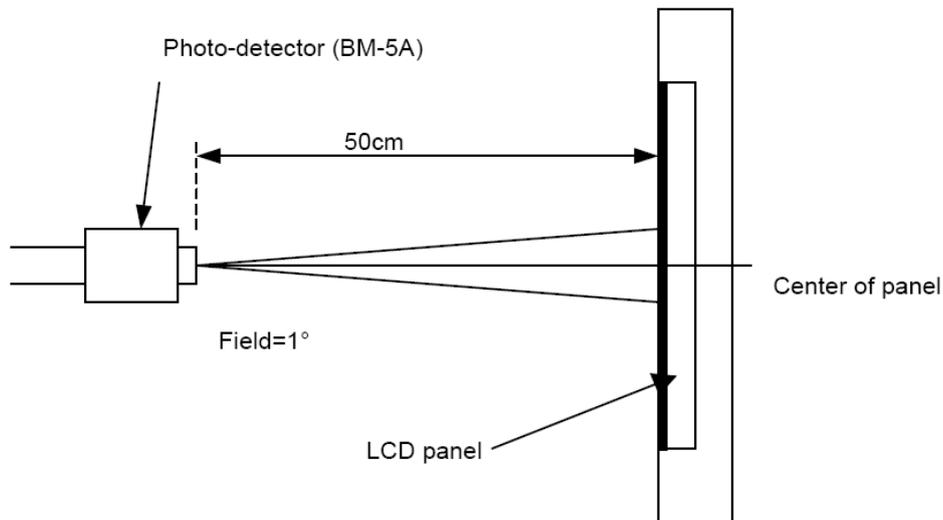
Measured at the center point of panel

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

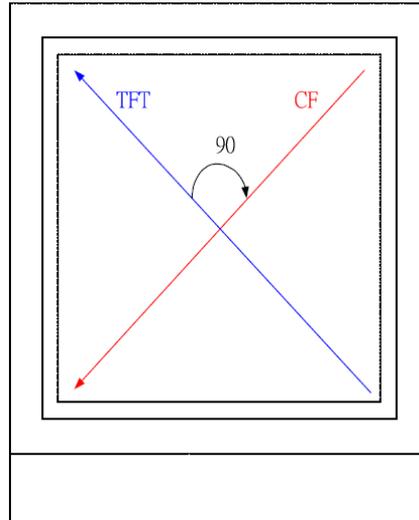
Note (3) Definition of Response Time: Sum of TR and TF



Note (4) Definition of optical measurement setup



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



10. Touch Panel Characteristics

10.1 General Standard Specifications

Item	Specification
Input Method	Finger or Stylus pen
ITO Glass	T=0.70mm (300~500Ω)
ITO Film	T=0.188mm (400Ω)
Operating Temperature Range	-20°C ~+70°C 20%~90%RH (Except for dew gathering)
Storage Temperature Range	-30°C ~+80°C 20%~90%RH (Except for dew gathering)
Surface Hardness	≥3H
Hitting Durability	1,000,000 times(pressure 150g , frequency 2 time/s)
Pen Sliding Durability	100,000 times(pressure 150g , speed 60mm/s)
Light Transparency	80% min.
Activation Force	≤100g individual point on with polyacetal stylus pen (R0.8mm)

10.2 Electrical Characteristic Specification

Item	Specification
Operating Voltage	DC 5V 1mA
Insulation Resistance	20MΩ (25V DC)
Chatting	≤ 10 ms
Linearity	≤1.5%

11. Reliability Test Conditions and Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
<input type="checkbox"/>	High Temperature Storage	80°C±2°C×200Hours	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1, Air bubble in the LCD. 2, Seal leak. 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 characteristic requirements shall be satisfied.
<input type="checkbox"/>	Low Temperature Storage	-30°C±2°C×200Hours	
<input type="checkbox"/>	High Temperature Operating	70°C±2°C×120Hours	
<input type="checkbox"/>	Low Temperature Operating	-20°C±2°C×120Hours	
<input type="checkbox"/>	Temperature Cycle(Storage)	-20°C ↔ 25°C ↔ 70°C (30min) (5min) (30min) ← 1cycle → Total 10cycle	
<input type="checkbox"/>	Damp Proof Test (Storage)	50°C±5°C×90%RH×120Hours	
<input type="checkbox"/>	Vibration Test	Frequency:10Hz~55Hz~10Hz Amplitude:1.5M X,Y,Z direction for total 3hours (Packing Condition)	
<input type="checkbox"/>	Drooping Test	Drop to the ground from 1M height one time every side of carton. (Packing Condition)	

□	ESD Test	Voltage:±8KV,R:330Ω,C:150PF,Air Mode,10times	
<p>REMARK:</p> <ol style="list-style-type: none"> 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 accepted 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. 			

12. Inspection Standard

This standard apply to C-STN/TFT module

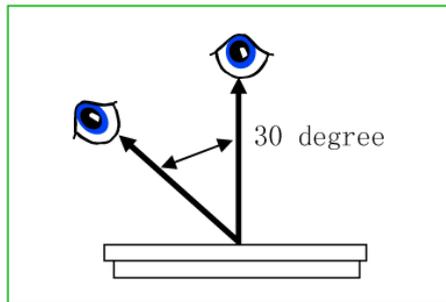
1. Spot check plan:

According to spot check level II ,MIL-STD-105D Level II ,the rank of accept or reject is below:

3A、 2A : major non-conformance : AQL 0.25 minor non-conformance : AQL 0.4

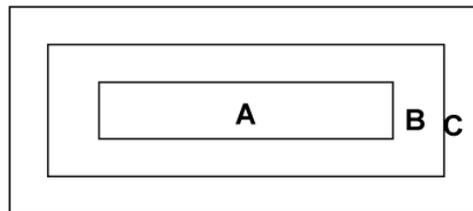
1A : major non-conformance : AQL 0.65 minor non-conformance : AQL 1.

2. Inspection condition:



Under daylight lamp 20~40W, product distance inspector 'eye 30cm,incline degree 30°.

3. LCD area define:



Area A: display area

Area B: VA area

Area C: out of VA area, not in sight after assembly

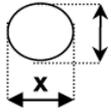
Remark: non-conformance at area C, but is OK that isn't influence reliability of product & assembly by customer.

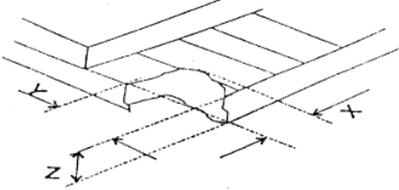
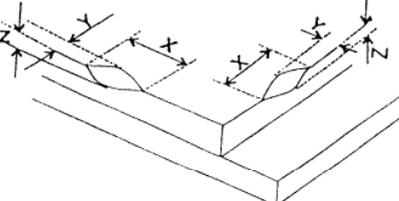
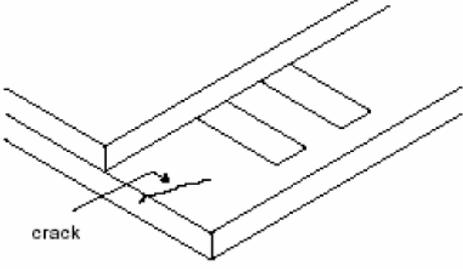
4. Inspection standard

4.1 Major non-conformance

NO.	Item	Inspection standard	Rate
4.1.1	Function non-conformance	1) No display, display abnormally 2) Miss line, short 3) B/L no function or function abnormally 4) TP no function	major
4.1.2	miss	No matter miss what component	
4.1.3	Out of size	Module dimension out of spec	

4.2 Appearance non-conformance

NO.	Item	Inspection standard	Rate																														
4.2.1	Black or white spot (power on)	dot non-conformance define Φ <div style="display: flex; align-items: center; justify-content: center; margin-top: 10px;"> $\Phi = \frac{+y}{2} \times ($  </div>	Minor																														
		A grade <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th rowspan="2" style="width: 30%;">area size (mm)</th> <th colspan="3" style="text-align: center;">Most approve q'ty</th> </tr> <tr> <th style="width: 15%;">A</th> <th style="width: 15%;">B</th> <th style="width: 15%;">C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.10$</td> <td colspan="3" style="text-align: center;">ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.15$</td> <td style="text-align: center;">4</td> <td colspan="2" rowspan="3" style="text-align: center; vertical-align: middle;">ignore</td> </tr> <tr> <td>$0.15 < \Phi \leq 0.20$</td> <td style="text-align: center;">2</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td style="text-align: center;">1</td> </tr> <tr> <td>$0.25 < \Phi$</td> <td style="text-align: center;">0</td> <td colspan="2"></td> </tr> </tbody> </table> <p style="margin-top: 10px;">Most approve 4 damages, dot to dot $\geq 10\text{mm}$</p>		area size (mm)	Most approve q'ty			A	B	C	$\Phi \leq 0.10$	ignore			$0.10 < \Phi \leq 0.15$	4	ignore		$0.15 < \Phi \leq 0.20$	2	$0.20 < \Phi \leq 0.25$	1	$0.25 < \Phi$	0									
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4.2.2	Black or white line (power on)	A grade <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="2" style="text-align: center;">Size(mm)</th> <th colspan="3" style="text-align: center;">Most approve q'ty</th> </tr> <tr> <th style="width: 20%;">L(length)</th> <th style="width: 20%;">W(width)</th> <th style="width: 15%;">A</th> <th style="width: 15%;">B</th> <th style="width: 15%;">C</th> </tr> </thead> <tbody> <tr> <td>ignore</td> <td>$W \leq 0.03$</td> <td colspan="3" style="text-align: center;">ignore</td> </tr> <tr> <td>$L \leq 5.0$</td> <td>$0.03 < W \leq 0.05$</td> <td colspan="3" style="text-align: center;">3</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.05 < W \leq 0.07$</td> <td colspan="3" style="text-align: center;">2</td> </tr> <tr> <td></td> <td>$0.07 < W$</td> <td colspan="3" style="text-align: center;">Treat with dot non-conformance</td> </tr> </tbody> </table> <p style="margin-top: 10px;">Most approve 3 damages, line to line $\geq 10\text{mm}$</p>	Size(mm)		Most approve q'ty			L(length)	W(width)	A	B	C	ignore	$W \leq 0.03$	ignore			$L \leq 5.0$	$0.03 < W \leq 0.05$	3			$L \leq 3.0$	$0.05 < W \leq 0.07$	2				$0.07 < W$	Treat with dot non-conformance			Minor
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	$0.07 < W$	Treat with dot non-conformance																															

4.2.3	Polarizer position	1) Polarizer attach meet drawing, disallow out of LCD. 2) Polarizer must cover display area (special require unless)	Minor												
4.2.4	LCD non-conformance	<p>(i) crash at side (remark: S=ITO length)</p>  <table border="1" data-bbox="609 674 1179 788"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0</td> <td>≤S</td> <td>ignore</td> </tr> </tbody> </table> <p>Crash disallow extend to ITO or seal.</p> <p>(ii) commonly surface scathe</p>  <table border="1" data-bbox="590 1133 1198 1247"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤2.0</td> <td><frame edge</td> <td>ignore</td> </tr> </tbody> </table> <p>(iii) crack</p> <p>Disallow extend crack</p> 	X	Y	Z	≤3.0	≤S	ignore	X	Y	Z	≤2.0	<frame edge	ignore	Minor
X	Y	Z													
≤3.0	≤S	ignore													
X	Y	Z													
≤2.0	<frame edge	ignore													
4.2.5	Contrast voltage warp	VOP/Vlcd voltage of confirmed sample ±0.15V	Minor												
4.2.6	color	Color & luminance of module scope reference spec	Minor												
4.2.7	Cross talk	Reference confirmed limit sample	Minor												

13. Handling Precautions

13.1 Mounting method

The LCD panel of AMSON TFT 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.

13.2 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.

13.3 Caution against static charge

The LCD module uses C-MOS LSI drivers, so we recommend that you:

Connect any unused input terminal to IOVCC or GND, 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.

13.4 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

13.5 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.
- 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.

13.6 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

13.7 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

14. Precaution for Use

14.1

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.

14.2

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.

15. Packing Method

TBD