

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	4.46" TFT	--
Dot arrangement	480(RGB)×854	dots
Color filter array	RGB vertical stripe	--
Display mode	Transmission / Normally Black	-
Viewing Direction	Full view	--
Driver IC	NT35512SH	--
Module size	60.0(W)×109.0(H)×1.87(T)	mm
Active area	55.44(W)×98.64(H)	mm
Interface	MIPI interface	--
Operating temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C
Back Light	10 White LED	--
Weight	TBD	g

4. Interface Description

CON1

PIN NO.	PIN NAME	DESCRIPTION
1	GND	Power ground
2~6	NC	No connection
7	GND	Power ground
8	ID	Add ID bit hardwired in flex, for display identification back to Sitar
9	VCI	Logic Supply Voltage
10	RESET	Reset pin setting either pin low initializes the chip
11	TE	Tearing effect
12	GND	Power ground
13	MIPI_0N	MIPI Negative data signal(-)
14	MIPI_0P	MIPI Positive data signal(+)
15	GND	Power ground
16	MIPI_1N	MIPI Negative data signal(-)
17	MIPI_1P	MIPI Positive data signal(+)
18	GND	Power ground
19~20	NC	No connection
21	GND	Power ground
22	MIPI_CKN	MIPI Negative clock signal(-)
23	MIPI_CKP	MIPI Positive clock signal(+)
24~25	GND	Power ground
26	VCC	Analog Supply Voltage
27	LEDK	The cathode of LED power
28	LEDA	The Anode of LED power
29	GND	Power ground
30	VIBR_PMU	---
31	GND	Power ground
32	SPEAKER+	---
33	SPEAKER+	---
34	SPEAKER-	---
35	SPEAKER-	---
36	GND	Power ground
37	MIC-	---
38	MIC+	---
39	GND	Power ground

CON2

PIN NO.	PIN NAME	DESCRIPTION
1	VIBR_PMU	---
2	GND	Power ground
3	SPEAKER+	---
4	SPEAKER+	---
5	SPEAKER-	---
6	SPEAKER-	---
7	GND	Power ground
8	MIC-	---
9	MIC+	---
10	GND	Power ground

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Logic Supply Voltage	V _{CI}	-0.3	3.6	V
Analog Supply Voltage	V _{CC}	-0.3	4.6	V
Input Voltage	V _{in}	-0.3	V _{CI} +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	V _{CI}	1.65	1.8	3.3	V	-
Analog Supply Voltage	V _{CC}	2.5	3.3	3.5	V	-
Input High Voltage	V _{IH}	0.7V _{CI}	-	V _{CI}	V	-
Input Low Voltage	V _{IL}	GND	-	0.3 V _{CI}	V	-
Output High Voltage	V _{OH}	0.8 V _{CI}	-	V _{CI}	V	-
Output Low Voltage	V _{OL}	GND	-	0.2 V _{CI}	V	-
I/O Leak Current	I _{LI}	-1	-	1	uA	-

7. Timing Characteristics

7.1 High Speed Mode

(VSS=VSSI=DVSS=0V, VDDI=1.65V to 3.3V, VDD=2.5V to 3.5V, Ta = -30 to 70 °C)

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
DSI-CLK+/-	$2xU_{INST}$	Double UI instantaneous	4	-	25	ns	
DSI-CLK+/-	U_{INSTA} U_{INSTB}	UI instantaneous halves	2	-	12.5	ns	UI = U_{INSTA} = U_{INSTB}
DSI-Dn+/-	t_{DS}	Data to clock setup time	$0.15xUI$	-	-	ps	
DSI-Dn+/-	t_{DH}	Data to clock hold time	$0.15xUI$	-	-	ps	
DSI-CLK+/-	t_{DRTCLK}	Differential rise time for clock	150	-	$0.3xUI$	ps	
DSI-Dn+/-	$t_{DRTDATA}$	Differential rise time for data	150	-	$0.3xUI$	ps	
DSI-CLK+/-	t_{DFTCLK}	Differential fall time for clock	150	-	$0.3xUI$	ps	
DSI-Dn+/-	$t_{DFTDATA}$	Differential fall time for data	150	-	$0.3xUI$	ps	

Note) Dn = D0 and D1.

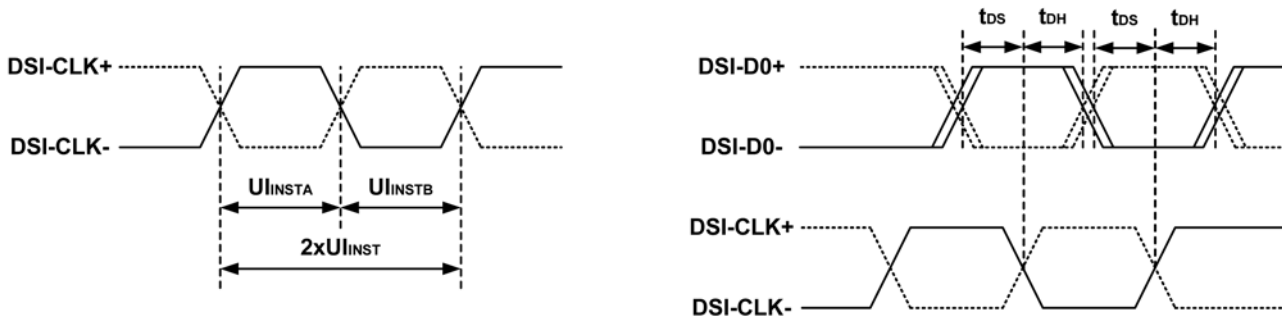


Fig. 7.1.1 DSI clock channel timing

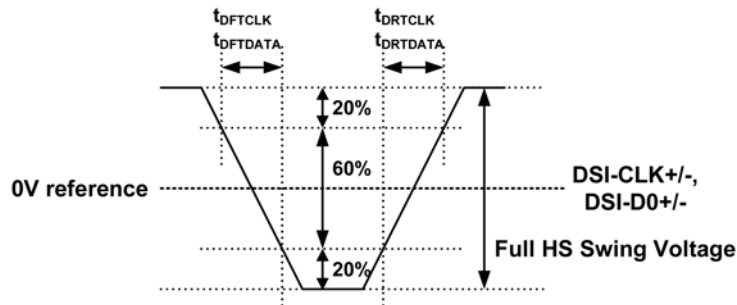


Fig. 7.1.2 Rising and fall time on clock and data channel

7.2 Low Power Mode

(VSS=VSSI=DVSS=0V, VDDI=1.65V to 3.3V, VDD=2.5V to 3.5V, Ta = -30 to 70 °C)

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
DSI-D0+/-	T _{LPXM}	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU ☒ Display Module	50	-	75	ns	Input
DSI-D0+/-	T _{LPXD}	Length of LP-00, LP-01, LP-10 or LP-11 periods Display Module ☒ MPU	50	-	75	ns	Output
DSI-D0+/-	T _{TA-SURED}	Time-out before the MPU start driving	T _{LPXD}	-	2xT _{LPXD}	ns	Output
DSI-D0+/-	T _{TA-GETD}	Time to drive LP-00 by display module	5xT _{LPXD}	-	-	ns	Input
DSI-D0+/-	T _{TA-GOD}	Time to drive LP-00 after turnaround request - MPU	4xT _{LPXD}	-	-	ns	Output

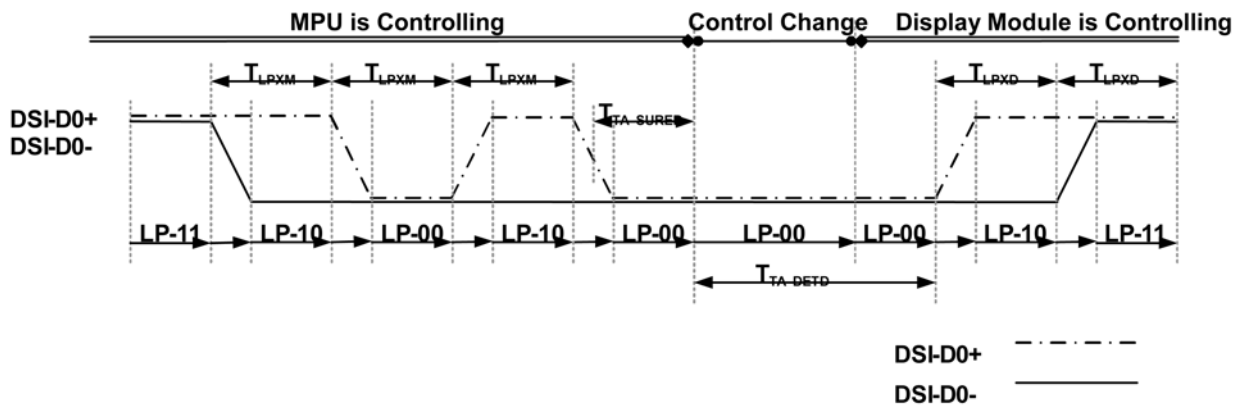


Fig. 7.2.1 Bus Turnaround (BAT) from MPU to display module Timing

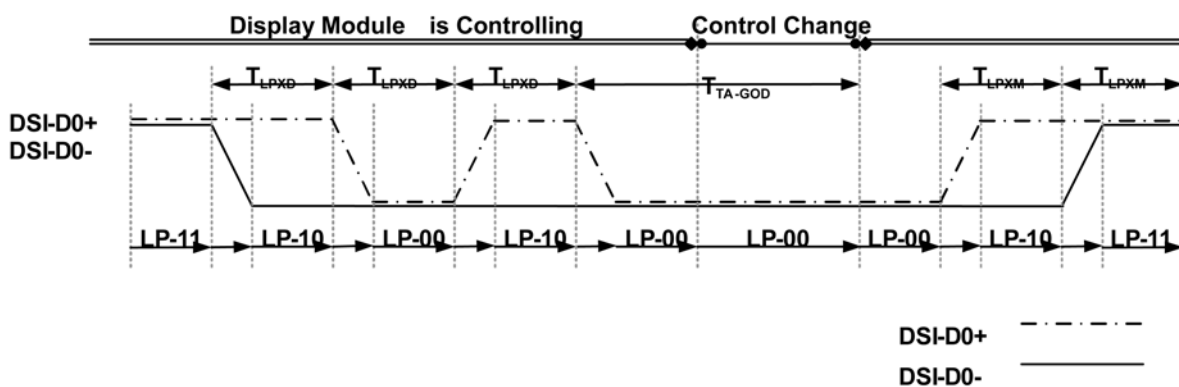


Fig. 7.2.2 Bus Turnaround (BAT) from display module to MPU Timing

7.3 DSI Bursts

(VSS=VSSI=DVSS=0V, VDDI=1.65V to 3.3V, VDD=2.5V to 3.5V, Ta = -30 to 70 °C)

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
Low Power Mode to High Speed Mode Timing							
DSI-Dn+/-	T _{LPX}	Length of any low power state period	50	-	-	ns	Input
DSI-Dn+/-	T _{HS-PREPARE}	Time to drive LP-00 to prepare for HS transmission	40+4xUI	-	85+6xUI	ns	Input
DSI-Dn+/-	T _{HS-TERM-EN}	Time to enable data receiver line termination measured from when Dn crosses V _{ILMAX}	-	-	35+4xUI	ns	Input
High Speed Mode to Low Power Mode Timing							
DSI-Dn+/-	T _{HS-SKIP}	Time-out at display module to ignore transition period of EoT	40	-	55+4xUI	ns	Input
DSI-Dn+/-	T _{HS-EXIT}	Time to drive LP-11 after HS burst	100	-	-	ns	Input
DSI-Dn+/-	T _{HS-TRAIL}	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60+4xUI	-	-	ns	Input
High Speed Mode to/from Low Power Mode Timing							
DSI-CLK+/-	T _{CLK-POS}	Time that the MPU shall continue sending HS clock after the last associated data lane has transition to LP mode	60+52xUI	-	-	ns	Input
DSI-CLK+/-	T _{CLK-TRAIL}	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60	-	-	ns	Input
DSI-CLK+/-	T _{HS-EXIT}	Time to drive LP-11 after HS burst	100	-	-	ns	Input
DSI-CLK+/-	T _{CLK-PREPARE}	Time to drive LP-00 to prepare for HS transmission	38	-	95	ns	Input
DSI-CLK+/-	T _{CLK-TERM-EN}	Time-out at clock lane display module to enable HS transmission	-	-	38	ns	Input
DSI-CLK+/-	T _{CLK-PREPARE} + T _{CLK-ZERO}	Minimum lead HS-0 drive period before starting clock	300	-	-	ns	Input
DSI-CLK+/-	T _{CLK-PRE}	Time that the HS clock shall be driven prior to any associated data lane beginning the transition from LP to HS mode	8xUI	-	-	ns	Input

Note) Dn = D0 and D1.

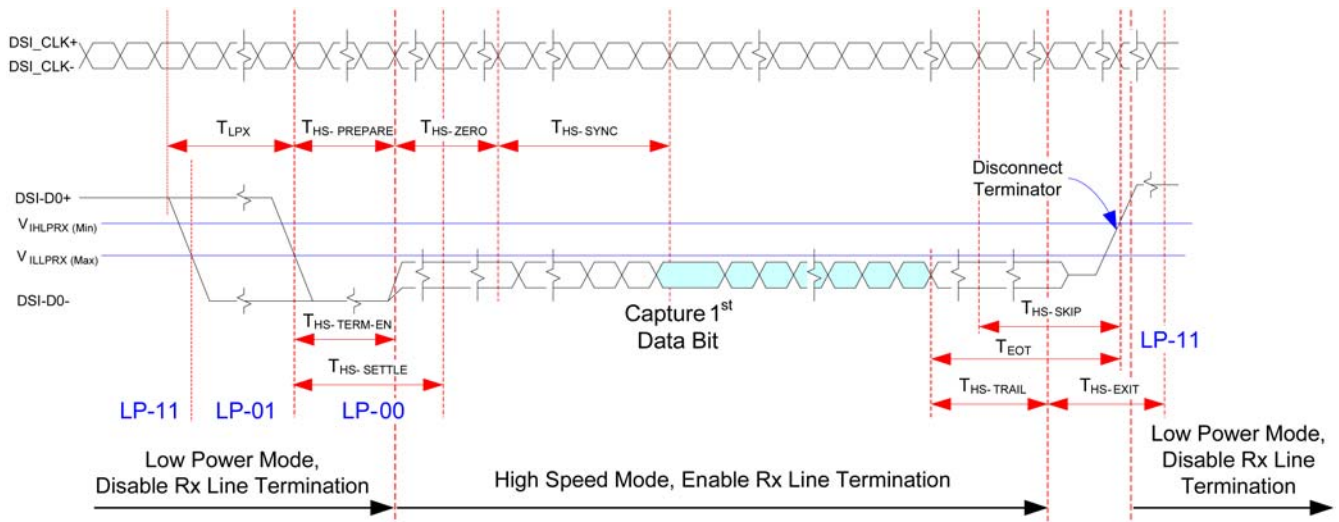


Fig. 7.3.1 Data lanes-Low Power Mode to/from High Speed Mode Timing

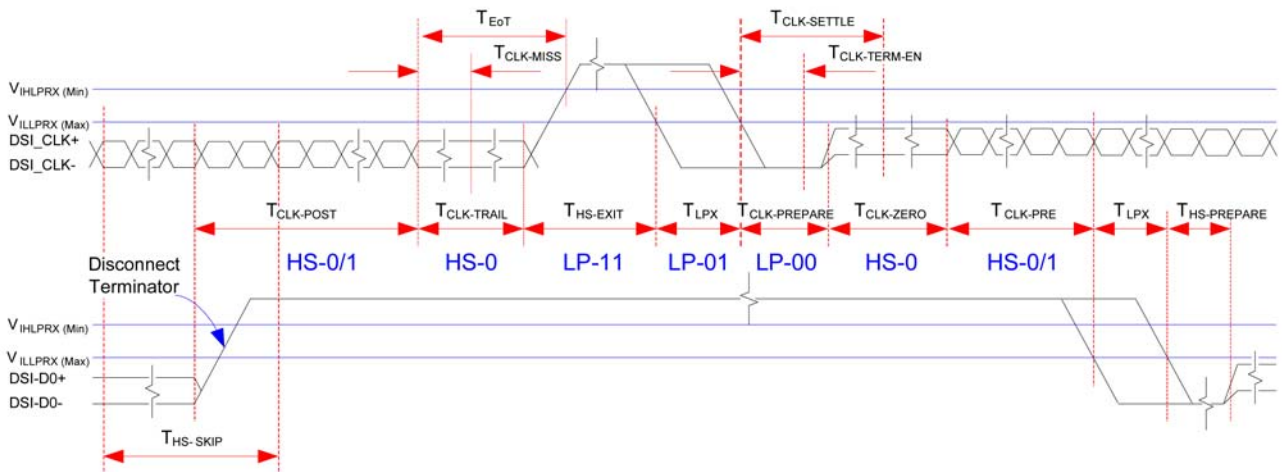


Fig. 7.3.2 Clock lanes- High Speed Mode to/from Low Power Mode Timing

7.4 Reset Timing Characteristics

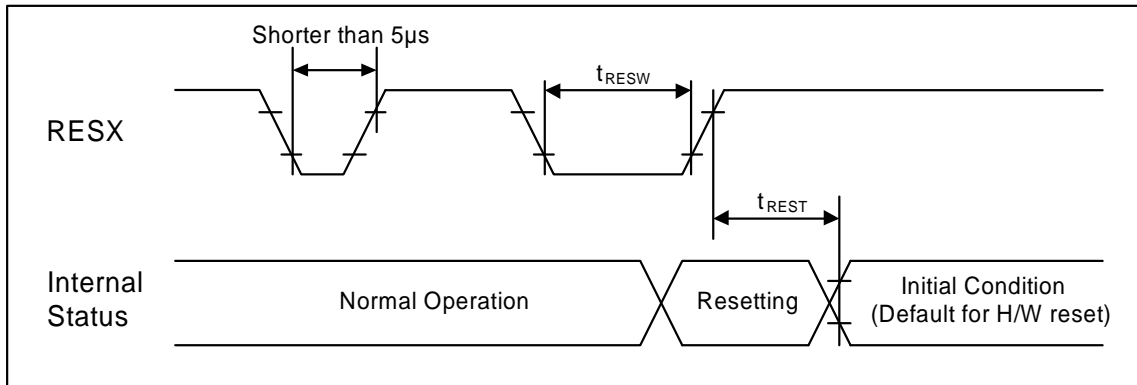


Fig. 7.4 Reset input timing

(VSS=VSSI=DVSS=0V, VDDI=1.65V to 3.3V, VDD=2.5V to 3.5V, Ta = -30 to 70 °C)

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
RESX	t _{RESW}	Reset "L" pulse width (Note 1)	10	-	-	µs	
	t _{REST}	Reset complete time (Note 2)	-	-	5	ms	When reset applied during Sleep In Mode
			-	-	120	ms	When reset applied during Sleep Out Mode

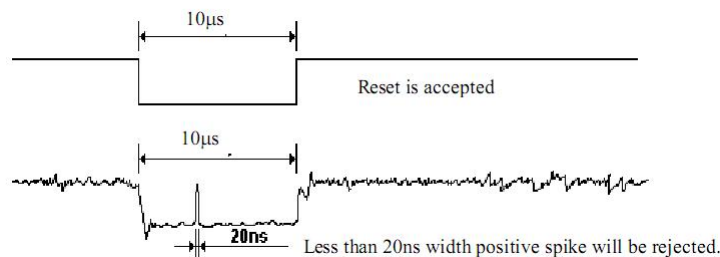
Note 1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shorter than 5µs	Reset Rejected
Longer than 9µs	Reset
Between 5µs and 9µs	Reset Start

Note 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.

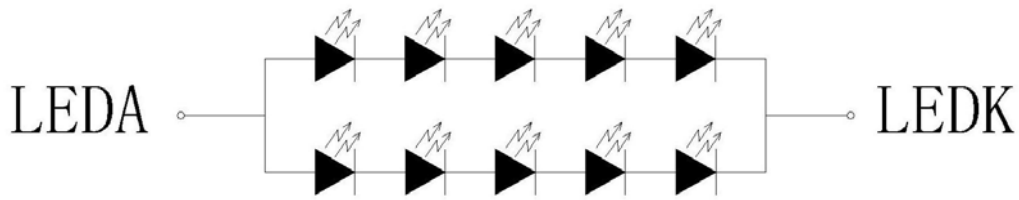
Note 3) During Reset Complete Time, values in OTP memory will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (t_{REST}) within 5ms after a rising edge of RESX.

Note 4) Spike Rejection also applies during a valid reset pulse as shown below:



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

8. Backlight Characteristic

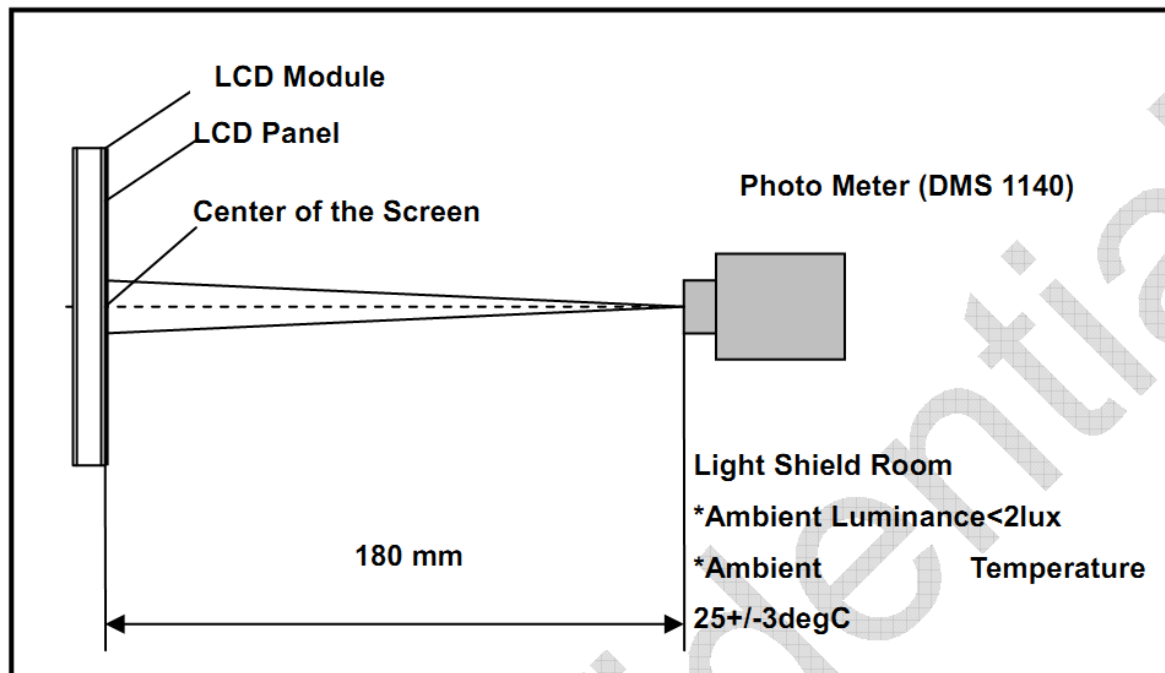


Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	14.5	16.0	17.5	V	If=40mA
Supply Current	If	-	40	50	mA	-
Luminous Intensity for LCM	-	200	250	-	cd/m ²	If=40mA
Uniformity for LCM	-	75	80	-	%	If=40mA
Life Time	-	-	20000	-	Hr	If=40mA
Backlight Color	White					

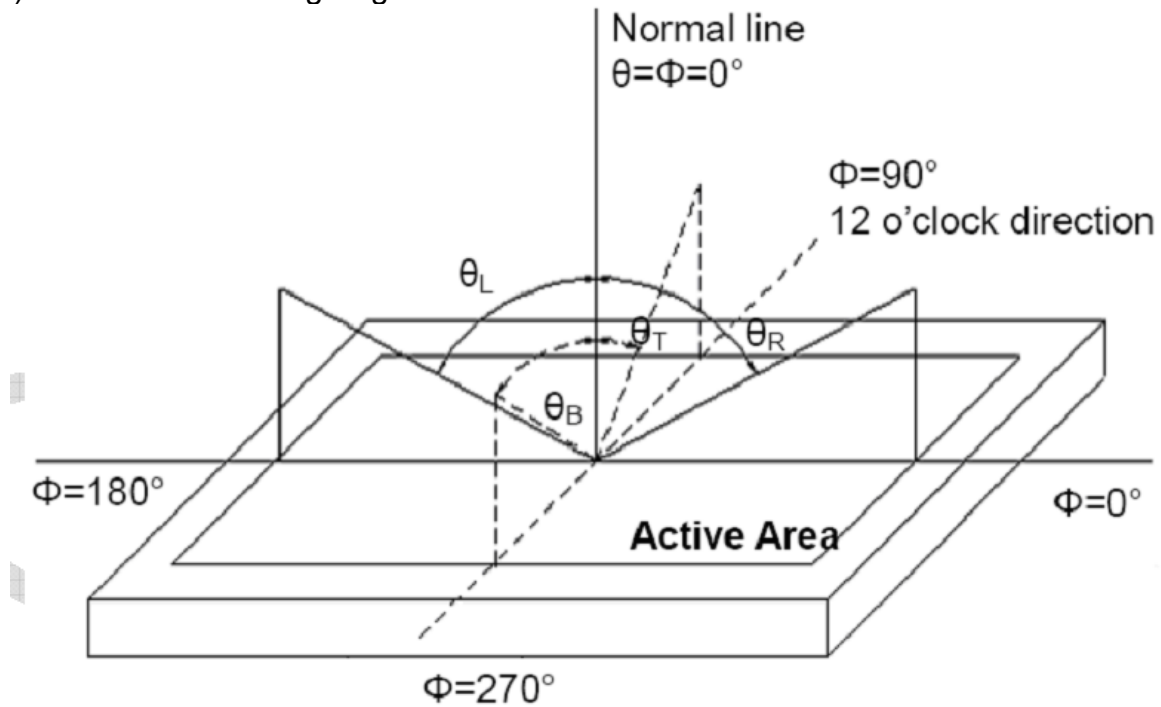
9. Optical Characteristics

Item	Conditions	Min.	Typ.	Max.	Unit	Note	
Viewing Angle (CR>10)	Horizontal	θ_L	-	80	-	degree	(1),(2),(6)
		θ_R	-	80	-		
	Vertical	θ_T	-	80	-		
		θ_B	-	80	-		
Contrast Ratio	Center	-	240	-	-	(1),(3),(6)	
LCM Luminance	Center point	200	250	-	Cd/m ²		
Response Time	Rising + Falling	-	30	40	ms	(1),(4),(6)	
CF Color Chromaticity (CIE1931)	Red x	Typ. +0.05	TBD	Typ. +0.05	-	(1), (6)	
	Red y		TBD		-		
	Green x		TBD		-		
	Green y		TBD		-		
	Blue x		TBD		-		
	Blue y		TBD		-		
	White x		TBD		-		
	White y		TBD		-		

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



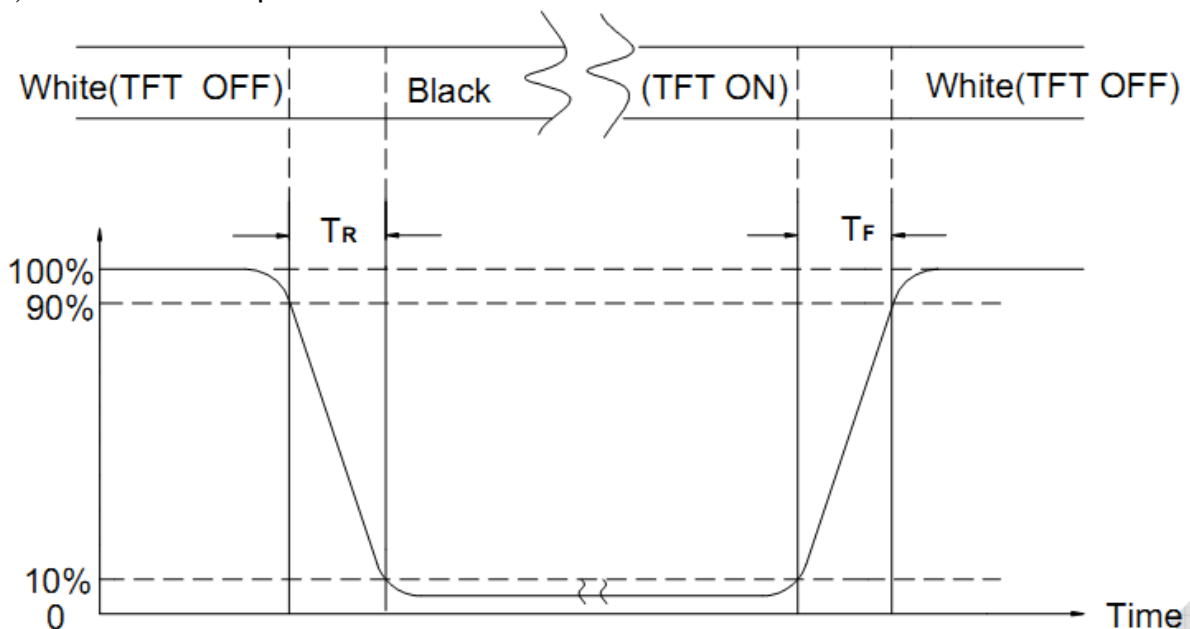
Note (3) Definition of Contrast Ratio (CR)

The contrast ratio can be calculated by the following expression

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

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)

$$\text{Transmittance} = \text{Center Luminance of LCD} / \text{Center Luminance of Back Light} \times 100\%$$

Note (6) Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of LCD

10. 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 test will be tested by a carton)	
<input type="checkbox"/>	Drooping Test	Drop to the ground from 1M height one time every side of carton. (packing condition test will be tested by a carton)	
<input type="checkbox"/>	ESD Test	Voltage:±8KV,R:330Ω,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 > 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.

11. Inspection Standard

1. AQL(Acceptable Quality Level)
 AQL of major and minor defect

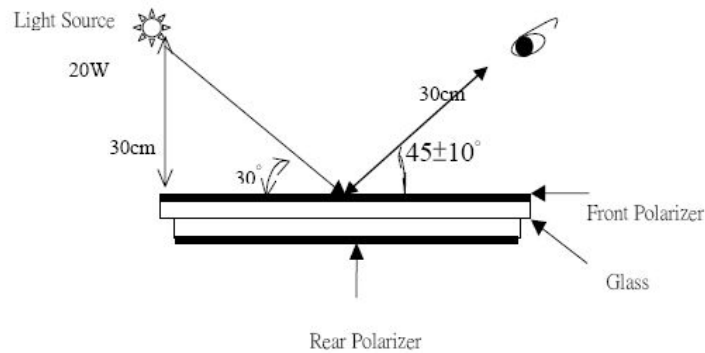
	MAJOR DEFECT	MINOR DEFECT	MAJOR+MINOR
APPEARANCE	0.40%	1.0%	1.0%
ELECTRIC-OPTICAL	0.15%	0.15%	0.15%

2. Basic conditions for inspection

The LCM face to us, in normal environment, the lux is 1000 ± 200 . (Darkroom' s lux: 100 ± 50),

About an angle of incidence 30, a distance of 30cm with normal eye,with an angle of 45 degree to check the products without uncovering the film!

(As shown below)

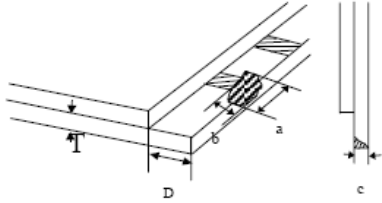
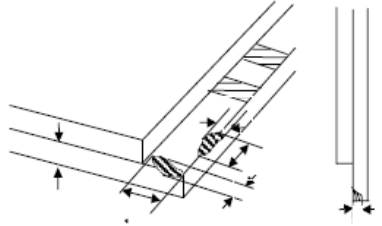


3. Inspection item and criteria

3.1 Visual inspection criterion in immobility

3.1.1 Glass defect

No	Defect item	Criteria	Remark
1	Dimension Unconformity (Major defect)	By Engineering Drawing	

No	Defect item	Criteria	Remark
2	Cracks (Major defect)	1.Linear cracks on panel 【Reject】 2. Nonlinear crack contrast by limited sample	
3	Glass extrude the conductive area (minor defect)	a: disregards and no influence assemblage 1) $b \leq 1/3$ Pin width (non bonding area) 【Accept】 2) bonding area ≤ 0.5 mm 【Accept】	a:Length, b:Width
4	Pin-side · conductive area damaged (minor defect)	(a c : disregards) $b \leq 1/3$ of effective length for bonding electrode 【Accept】	a: Length · b: Width · c: Thickness 
5	Pin-side · non-conductive area damaged (minor defect)	1) Damage area don't touch the ITO (Inclueing contraposition mark, except scribing mark) 【Accept】 2) $c < T$ $b \leq BM$ 1/3 of width 【Accept】 3) $c = T$ b not touch the seal glue 【Accept】 4) a disregards	a: Length · b: Width · c: Thickness 

12. Handling Precautions

12.1 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.

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 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.

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.
- 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