Microtips TECHNOLOGY

Model No: AWK-240240T15PC02D

This module uses ROHS material

Approved By	

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Revision Record

Rev No.	Rev Date	Contents	Note
A	2021/05/28	New issue	ALL
B	2021/07/27	CHANGE THE COVER PLATE TO PMMA	4 5

Table of Contents

1. Scope

This specification defines general provisions as well as inspection standards for TFT module supplied by Microtips Technology. If the event of unforeseen problem or unspecified items may occur, naturally shall negotiate and agree to solution

2. General Information

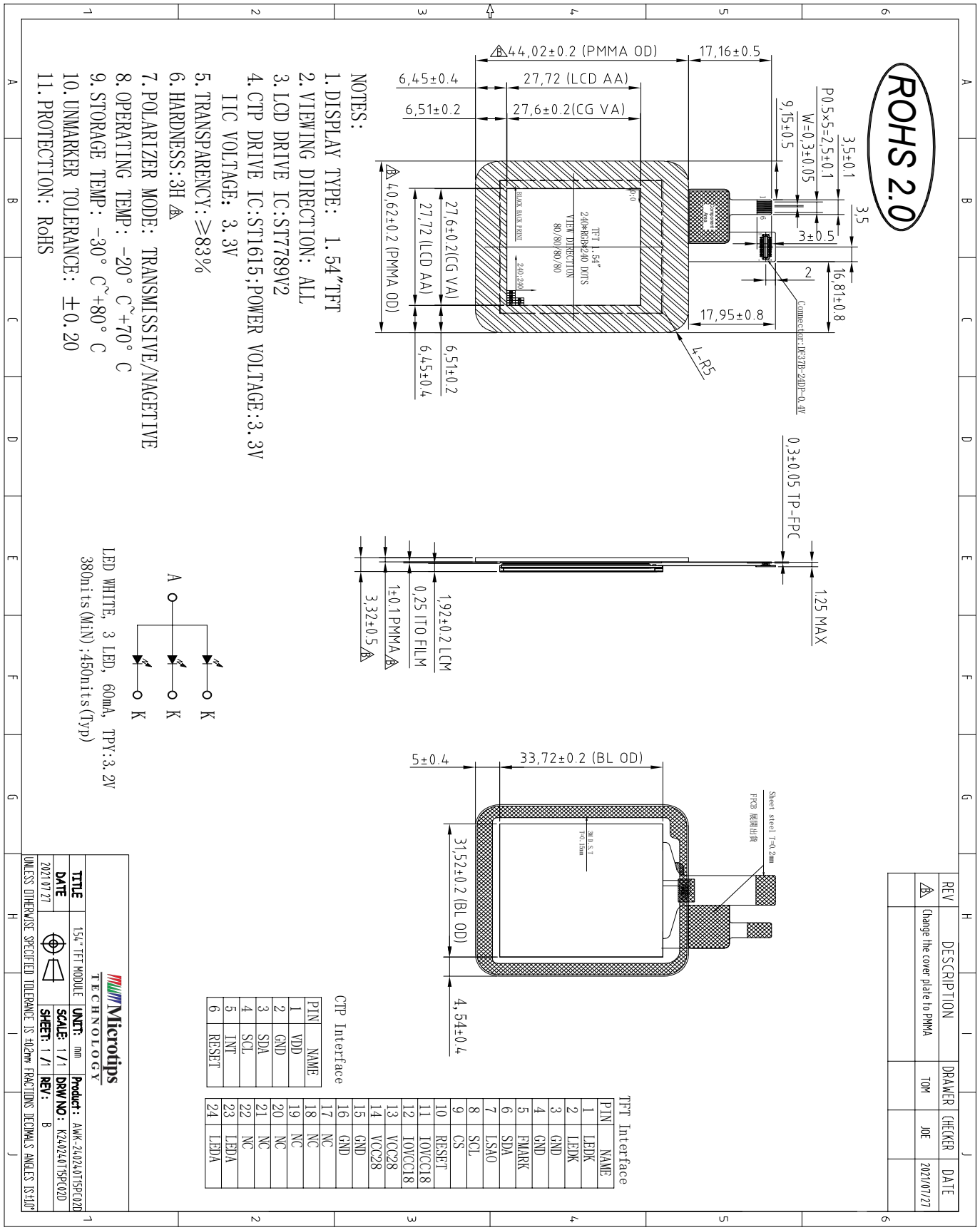
LCM

Item	Standard Values	Units
LCD type	1.54”TFT	--
Dot arrangement	240 (RGB)×240	dots
Color filter array	RGB vertical stripe	--
Display mode	IPS / Normally Black	--
Gray Scale Inversion Direction	80/80/80/80	--
Eyes Viewing Direction	ALL	--
Driver IC	ST7789V2	--
Module size	40.62(W)×44.02(H)×3.32(T)	mm
Active area	27.72(W)×27.72(H)	mm
Dot pitch	0.1155(W)×0.1155(H)	mm
Interface	4-line 8bit SPI	--
Operating temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C
Back Light	3 White LEDS	--

CTP

Item	Standard Values	Units
CTP type	PMMA + film + FPC	Soda line
CTP Driver IC	ST1615	--
Surface hardness	3H	--
Transmittance	≥83%	--
Operation Voltage	3.3 V	--
CTP size	40.62(W)×44.02(H)×1.5(T)	mm(with adhesive)
LENS Viewing area	27.6(W)×27.6(H)	mm
Operating temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C
CTP Interface	I²C	-

3. External Dimensions



4. Interface Description

LCM

Pin No.	Pin Name	Description
1	LEDK	LED backlight (Cathode).
2	LEDK	LED backlight (Cathode).
3	GND	System Ground
4	GND	System Ground
5	FMARK	Tearing effect signal is used to synchronize MCU to frame memory writing.
6	SDA	Serial input & output signal in SPI I/F.
7	LSAO	Data enable signal in SPI
8	SCL	A synchronous clock signal in SPI I/F.
9	CS	Input pin for chip selection signal.
10	RESET	Reset pin. Initializes the IC, when this signal is low. Must be reset after power is stable.
11	IOVCC18	Power supply for logic.
12	IOVCC18	Power supply for logic.
13	VCC28	Power supply for analog.
14	VCC28	Power supply for analog.
15	GND	System Ground
16	GND	System Ground
17~22	NC	No connection
23	LEDA	LED backlight (Anode).
24	LEDA	LED backlight (Anode).

CTP

PIN NO.	PIN NAME	
1	VDD	CTP Digital Power.
2	GND	CTP Power ground
3	SDA	CTP I^2C_data
4	SCL	CTP I^2C_clock.
5	INT	CTP interruption signal.
6	RESET	CTP reset pin.

5. Absolute Maximum Ratings

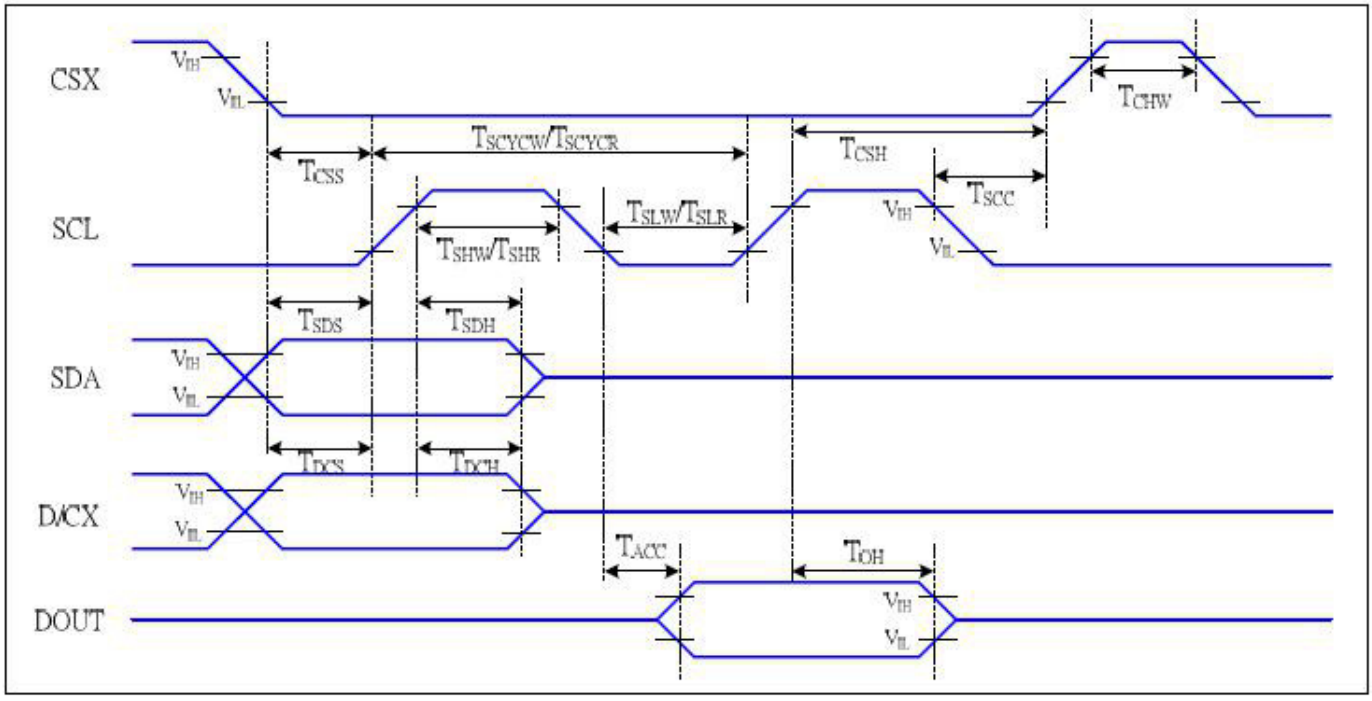
Item	Symbol	Min.	Max.	Unit
Power supply for analog.	VCC28	-0.3	4.6	V
Power supply for logic.	IOVCC18	-0.3	4.6	V
CTP Digital Power.	VDD	-0.3	6.0	V
Input Voltage	Vin	-0.3	IOVCC +0.5	V
Operating Temperature	TOP	-20	70	°C
Storage Temperature	TST	-30	80	°C
Storage Humidity	HD	20	90	%RH

6. DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply for analog voltage	VCC28	2.4	2.8	3.3	V	-
Power supply for analog current	Ivcc28	TBD	TBD	TBD	mA	-
Power supply for logic.	IOVCC18	1.65	1.8	3.3	V	-
CTP Digital Power.	VDD	2.7	3.3	3.6	V	-
Input High Voltage	V_{IH}	0.7IOVCC	-	IOVCC	V	-
Input Low Voltage	V_{IL}	GND	-	0.3 IOVCC	V	-
Output High Voltage	V_{OH}	0.8IOVCC	-	IOVCC	V	-
Output Low Voltage	V_{OL}	GND	-	0.2IOVCC	V	-
I/O Leak Current	ILI	-1	-	1	uA	-

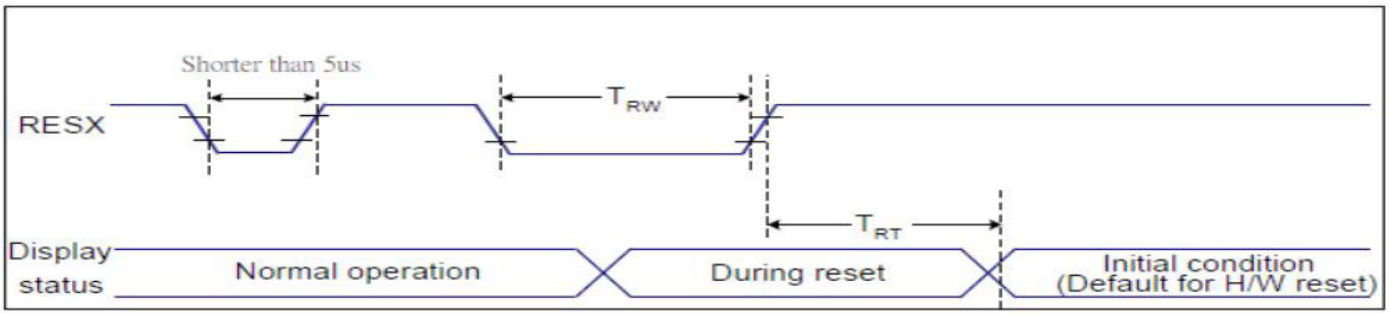
7. Timing Characteristics

7.1 Display Serial Interface Timing Characteristics (4-line SPI system)



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	16		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	7		ns	
	T_{SDH}	Data hold time	7		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

7.2 Reset Timing Characteristics



Related Pins	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

Notes:

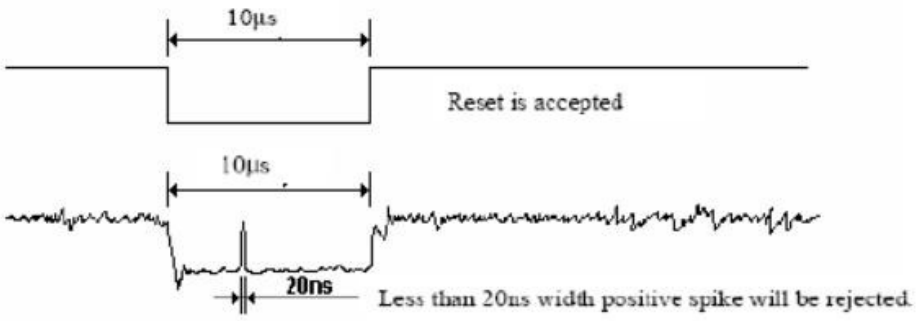
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

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 9us	Reset
Between 5us and 9us	Reset starts

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.

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



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

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

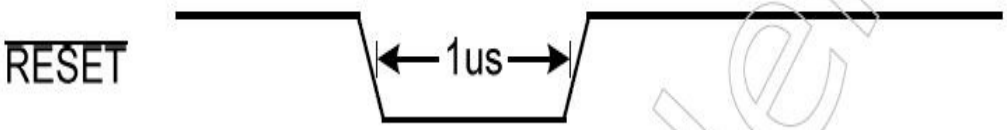
7.3CTP Timing

Power Down

In power down mode, all of the clocks of ST1615 are stopped. The way to exit power down mode is by a hardware reset or I2C.

Reset

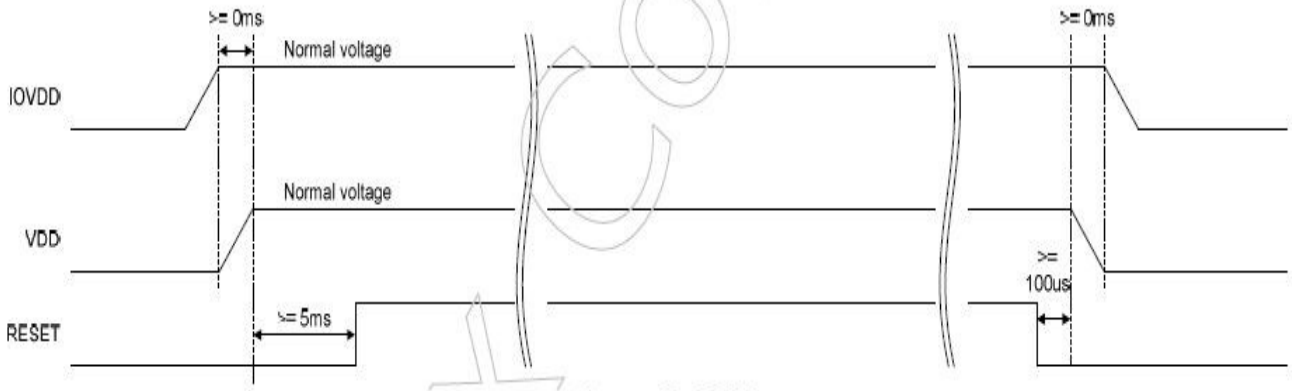
Master can reset ST1615 through RESET pin. RESET pin is low active and needs hold low for 1us to take effect.



$\overline{\text{RESET}}$ Pin Low Pulse Width

Power On/Off Sequence

RESET pin should be held low before power on and power off. During power on, after both VDD and IOVDD reach normal voltage, RESET pin needs to be held low for 5ms to ensure internal block stable.

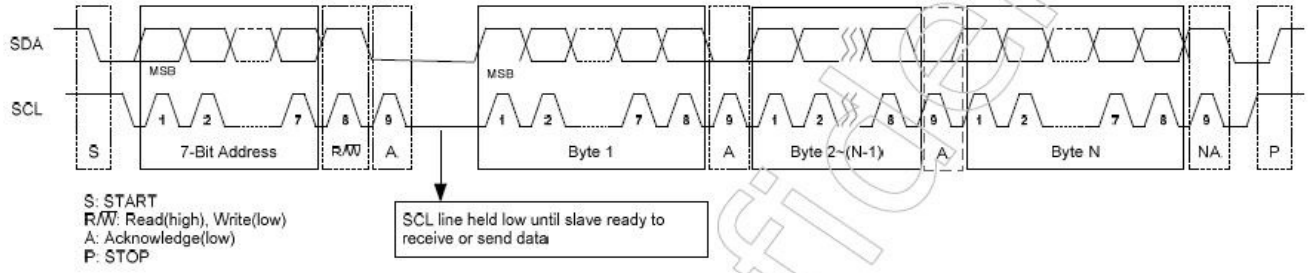


Power On/Off Sequence

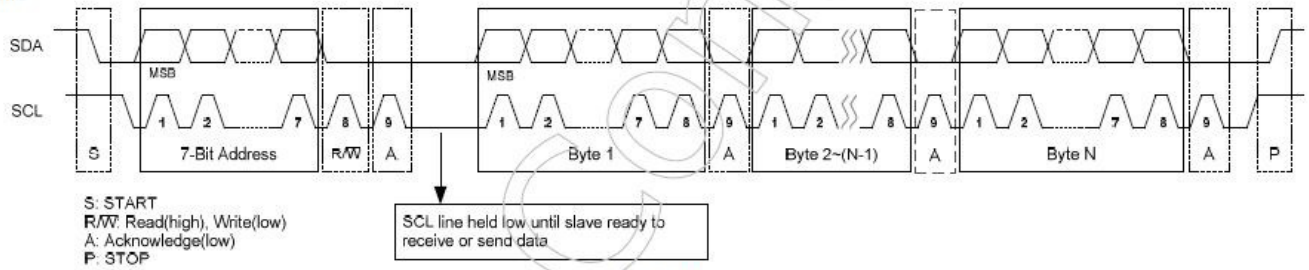
I2C Slave Interface

ST1615 equipped with I2C provides two wires, serial data (SDA) and serial clock (SCL), to carry transferring information at up to 400 kbit/s(Fast mode). ST1615 plays the slave role in I2C transfer. Both SDA and SCL are bidirectional lines, connected to IOVDD via pull-up resistors. All transactions begin with a START (S) and can be terminated by a STOP (P). 7-bits address follows START to recognize device. Each bye is 8-bits length and followed by an acknowledge bit. A HIGH to LOW transition on the SDA line while SCL is HIGH defines a START condition. A LOW to HIGH transition on the SDA line while SCL is HIGH defines a STOP condition. The data on the SDA line must be stable during the HIGH period of the clock. The HIGH or LOW state of the data line can only change when the clock signal on the SCL line is LOW.

Read



Write



I2C Waveform

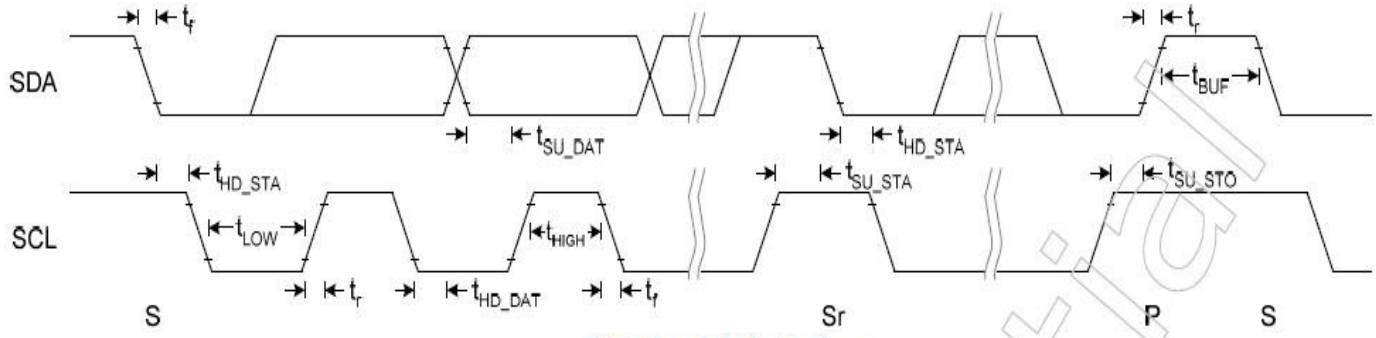
DC Electrical Characteristics

System DC Electrical Characteristics

Condition: VDD = IOVDD = 3.3V, T_A = 25°C, unless be specified individually.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
VDD	V_{VDD}	2.7	-	3.6	V	
IOVDD	V_{IOVDD}	1.6	-	3.6	V	
Operating Current	I_{NML}	-	TBD	-	mA	
Idle Current	I_{IDLE}	-	TBD	-	mA	
Power Down Current	I_{PD}	-	-	20	uA	
Input High Voltage	V_{IH}	0.85*IOVDD	-	-	V	
Input Low Voltage	V_{IL}	-	-	0.15*IOVDD	V	
Input Pull Up Resistor	R_{PU}	50	-	60	KOhm	
Output Driving Current	I_{DRV}	6	-	-	mA	V_{OH} = IOVDD x 0.8
Output Sinking Current	I_{SINK}	10	-	-	mA	V_{OL} = IOVDD x 0.2
Low Voltage Reset	V_{LVR}	-	-	2.3	V	

AC Electrical Characteristics



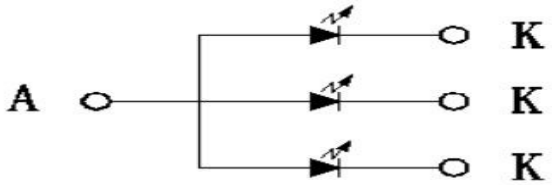
I2C Fast Mode Timing

I2C Fast Mode Timing Characteristic

Conditions: VDD = 3.3V, GND = 0V, T_A = 25°C

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
f_{SCL}	SCL clock frequency	0	-	400	kHz
t_{LOW}	Low period of the SCL clock	1.3	-	-	us
t_{HIGH}	High period of the SCL clock	0.6	-	-	us
t_f	Signal falling time	-	-	300	ns
t_r	Signal rising time	-	-	300	ns
t_{SU_STA}	Set up time for a repeated START condition	0.6	-	-	us
t_{HD_STA}	Hold time (repeated) START condition. After this period, the first clock pulse is generated	0.6	-	-	us
t_{SU_DAT}	Data set up time	100	-	-	ns
t_{HD_DAT}	Data hold time	0	-	0.9	us
t_{SU_STO}	Set up time for STOP condition	0.6	-	-	us
t_{BUF}	Bus free time between a STOP and START condition	1.3	-	-	us
C_b	Capacitive load for each bus line	-	-	400	pF

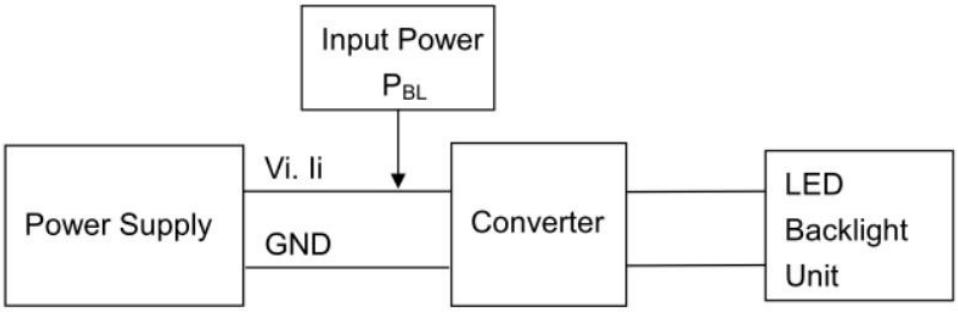
8. Backlight Characteristic



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	2.8	3.2	3.6	V	If=60mA
Supply Current	If	-	60	-	mA	-
Life Time	-	-	20000	-	Hr	If=60mA
Backlight Color	White					

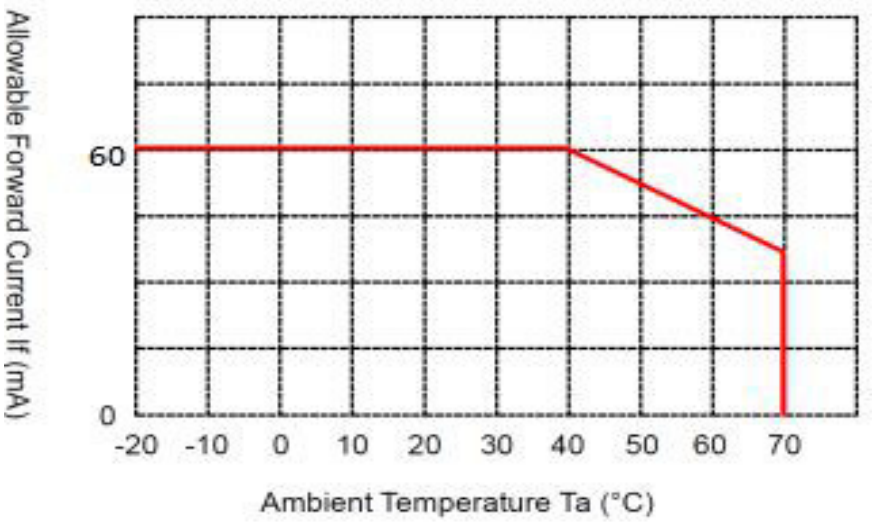
Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and If = 60mA.

Note 2: LED current is measured by utilizing a high frequency current meter as shown below:



Note 3: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and If = 60mA.. The LED lifetime could be decreased if operating If is larger than 60mA

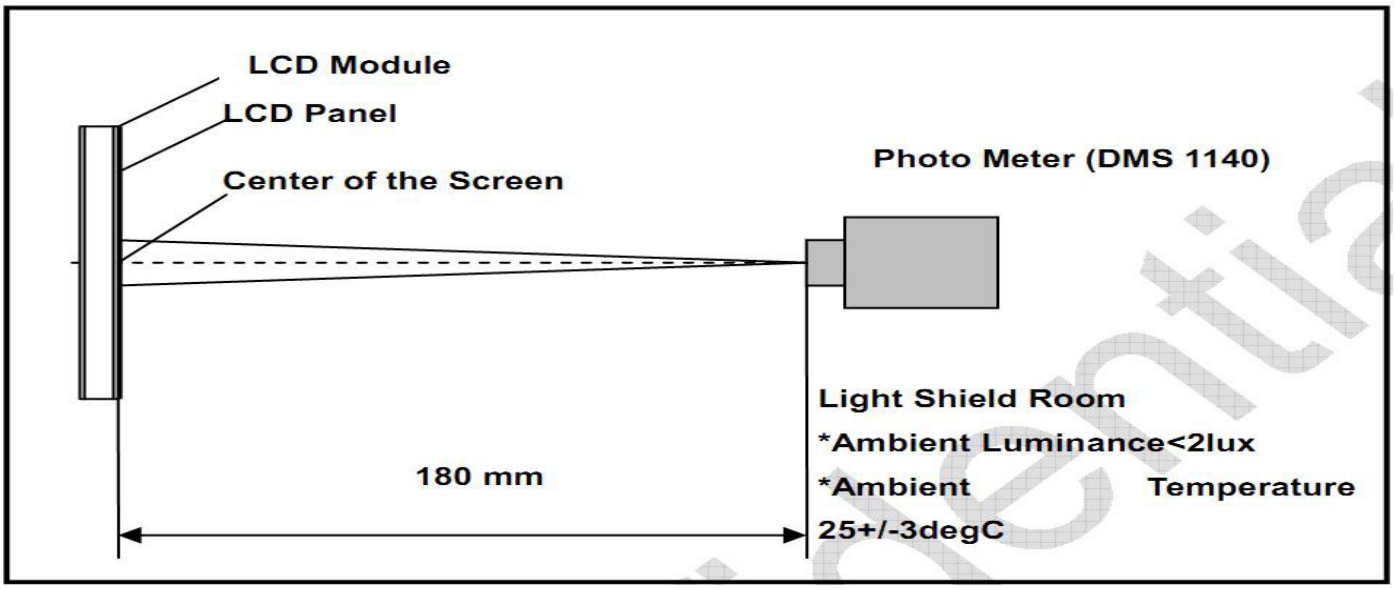
Note 4: LED light bar circuit:



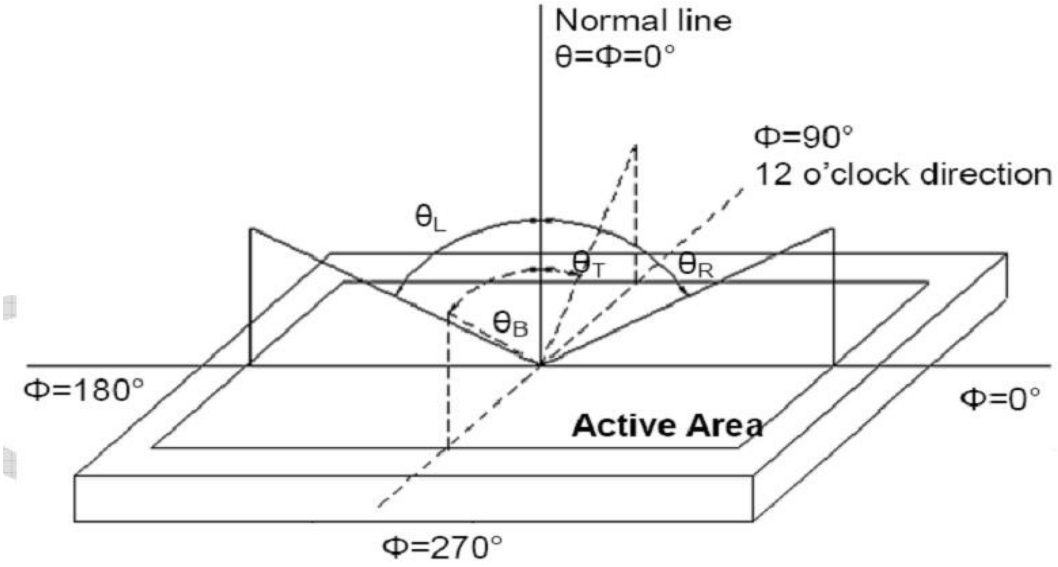
9. Optical Characteristics

Item	Conditions		Min.	Typ.	Max.	Unit	Note
Viewing Angle (CR>10)	Horizontal	θL	-	80	-	degree	(1),(2),(6)
		θR	-	80	-		
	Vertical	θT	-	80	-		
		θB	-	80	-		
Luminous Intensity for LCM	-		380	450	-	cd/m2	If=60mA
Uniformity for LCM	-		70	75	-	%	If=60mA
Contrast Ratio	Center		-	800	-	-	(1),(3),(6)
Response Time	Rising + Falling		-	30	40	ms	(1),(4),(6)
CF Color Chromaticity (CIE1931)	White x		TBD	TBD	TBD	-	(1), (6)
	White y		TBD	TBD	TBD	-	
	Red x		TBD	TBD	TBD	-	
	Red y		TBD	TBD	TBD	-	
	Green x		TBD	TBD	TBD	-	
	Green y		TBD	TBD	TBD	-	
	Blue x		TBD	TBD	TBD	-	
	Blue y		TBD	TBD	TBD	-	
NTSC	-		-	61	-	%	

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



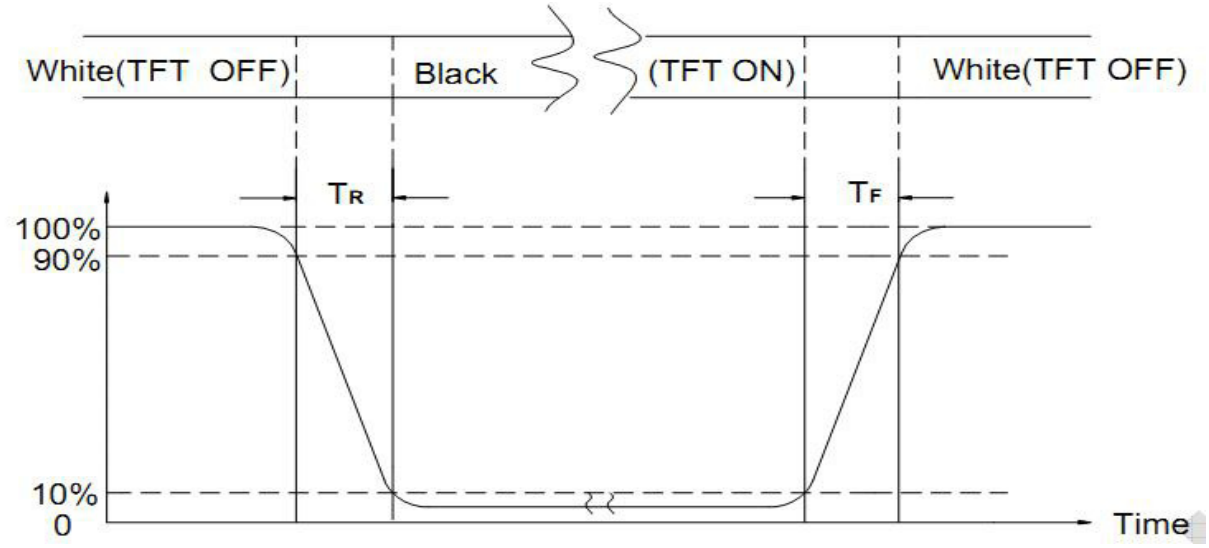
Note (3) Definition of Contrast Ratio (CR)

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.	Test Items	Test Condition	Inspection After Test
①	High Temperature Storage	80°C±2°C×96Hours	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.
②	Low Temperature Storage	-30°C±2°C×96Hours	
③	High Temperature Operating	70°C±2°C×96Hours	
④	Low Temperature Operating	-20°C±2°C×96Hours	
⑤	Temperature Cycle(Storage)	-20°C (30min) ⟺ 25°C (5min) ⟺ 70°C (30min) 1cycle Total 10cycle	
⑥	Damp Proof Test (Storage)	50°C±5°C×90%RH×96Hours	
⑦	Vibration Test	Frequency:10Hz~55Hz~10Hz Amplitude:1.5mm X,Y,Z direction for total 3hours (packing condition test will be tested by a carton)	
⑧	Drooping Test	Drop to the ground from 1M height one time every side of carton. (packing condition test will be tested by a carton)	
⑨	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

11.1 Scope

Specifications contain

11.1.1 Display Quality Evaluation

11.1.2 Mechanics Specification

11.2 Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow

MIL-STD-105E.

11.2.1 Lot size: Quantity per shipment as one lot (different model as different lot).

11.2.2 Sampling type: Normal inspection, single sampling.

11.2.3 Sampling level: Level II.

11.2.4 AQL: Acceptable Quality Level

Major defect: AQL=0.65

Minor defect: AQL=1.5

11.3 Panel Inspection Condition

11.3.1 Environment:

Room Temperature: 25±5°C.

Humidity: 65±5% RH.

Illumination: 300 ~ 700 Lux.

11.3.2 Inspection Distance:

35±5 cm

11.3.3 Inspection Angle:

The vision of inspector should be perpendicular to the surface of the Module.

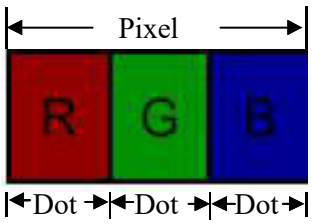
11.3.4 Inspection time：

Perceptibility Test Time: 20 seconds max.

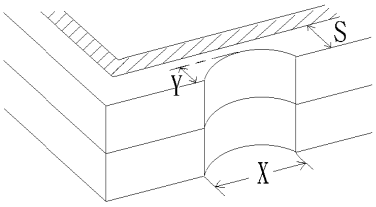
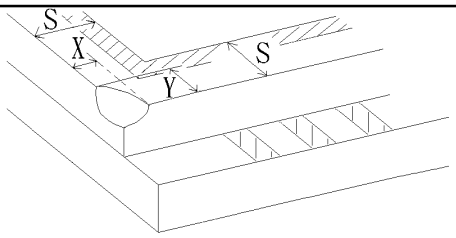
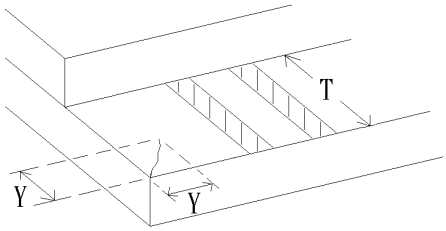
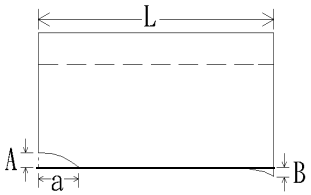
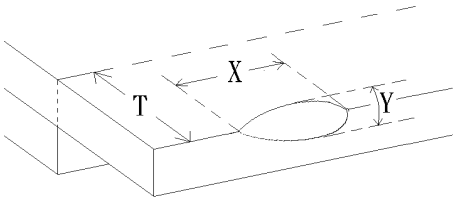
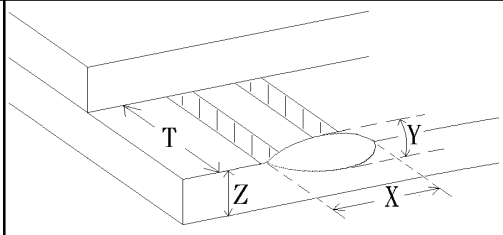
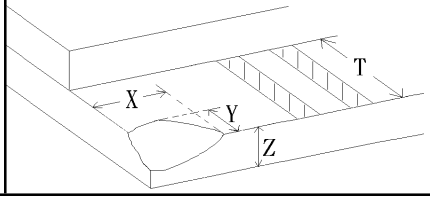
11.4 Inspection Plan

Class	Item	Judgment	Class
Packing & Indicate	1. Outside and inside package.	"MODEL NO.", "LOT NO." and "QUANTITY" should indicate on the package.	Minor
	2. Model mixed and quantity.	Other model mixed Quantity short or over	Major
	3. Product indication.	"MODEL NO." should indicate on the product.	Major
Assembly	4. Dimension, LCD glass scratch and scribe defect.	According to specification or drawing.	Major
Appearance	5. Viewing area.	Polarizer edge or LCD's sealing line is visible in the viewing area…….Rejected.	Minor
	6. Blemish, black spot, white spot in the LCD and LCD glass cracks.	According to standard of visual inspection.(inside viewing area)	Minor
	7. Blemish, black spot, white spot and scratch on the polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	8. Bubble in polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	9. LCD's rainbow color.	Strong deviation color (or newton ring) of LCD…….....Rejected. Or according to limited sample.(if needed, and inside viewing area)	Minor
Electrical	10. Electrical and optical characteristics.(contrast Vop chromaticity….etc)	According to specification or drawing.(inside viewing area)	Major
	11. Missing line.	Missing dot line character	Major
	12.Short circuit. Wrong pattern display.	No display, wrong pattern display, current consumption. Out of specification	Major
	13. Dot defect.(for color and TFT)	According to standard of visual Inspection.	Minor

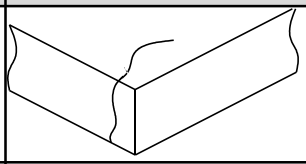
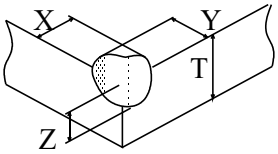
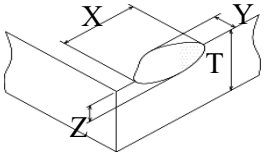
11.5 Standard Of Visual Inspection

<table>
<tr><th>NO.</th><th>CLASS</th><th>ITEM</th><th>JUDGMENT</th></tr>
<tr><td>11.5.1</td><td>Minor</td><td>Black and white spot.
Foreign materiel.
Dust.
Blemish.
Scratch.</td><td>(A) Round type: Unit: mm
<table>
<tr><th>Diameter (mm.)</th><th>Acceptable Q'ty</th></tr>
<tr><td>Φ≦0.2</td><td>Disregard</td></tr>
<tr><td>0.2 < Φ≦0.25</td><td>3(Distance>5mm)</td></tr>
<tr><td>0.25 < Φ</td><td>0</td></tr>
</table>
Note: Φ = (length+width)/2
(B) Linear type: Unit: mm
<table>
<tr><th>Length</th><th>Width (mm.)</th><th>Acceptable Q'ty</th></tr>
<tr><td>--</td><td>W≦0.03</td><td>Disregard</td></tr>
<tr><td>L≦5.0</td><td>0.03< W≦0.07</td><td>2(Distance>5mm)</td></tr>
<tr><td>--</td><td>0.07 < W</td><td>FOLLOW ROUND TYPE</td></tr>
</table></td></tr>
<tr><td>11.5.2</td><td>Minor</td><td>Dent on polarizer.</td><td>Unit: mm.
<table>
<tr><th>Diameter</th><th>Acceptable Q'ty</th></tr>
<tr><td>Φ≦0.2</td><td>Disregard</td></tr>
<tr><td>0.2 < Φ≦0.5</td><td>2(Distance>5mm)</td></tr>
<tr><td>0.5 < Φ</td><td>0</td></tr>
</table></td></tr>
<tr><td>11.5.3</td><td>Minor</td><td>Bubble in polarizer.</td><td>Unit: mm.
<table>
<tr><th>Diameter</th><th>Acceptable Q'ty</th></tr>
<tr><td>Φ≦0.2</td><td>Disregard</td></tr>
<tr><td>0.2< Φ≦0.5</td><td>2(Distance>5mm)</td></tr>
<tr><td>0.5 < Φ</td><td>0</td></tr>
</table></td></tr>
<tr><td>11.5.4</td><td>Minor</td><td>Dot defect</td><td>
<table>
<tr><th>Items</th><th>Acceptable Q'ty</th></tr>
<tr><td>Bright dot</td><td>N ≦1</td></tr>
<tr><td>Dark dot</td><td>N ≦1</td></tr>
<tr><td>Total dot</td><td>N ≦2</td></tr>
</table>
Pixel define :
 

Note1: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.
Note 2: Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
Note 3: The bright dot defect must be visible through 2% ND filter
Note 4: Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.</td></tr>
</table>

No.	Class	Item	Judgment
11.5.5	Minor	LCD glass chipping.	 Y>S Reject
11.5.6	Minor	LCD glass chipping.	 X or Y>S Reject
11.5.7	Major	LCD glass crack.	 Y>(1/2) T Reject
11.5.8	Major	LCD glass scribe defect.	 1. a>L/3, A>1.5mm Reject 2. B : According to dimension
11.5.9	Minor	LCD glass chipping. (on the terminal area)	 Φ = (x+y)/2>2.5mm Reject
11.5.10	Minor	LCD glass chipping. (on the terminal surface)	 Y>(1/3)T Reject
11.5.11	Minor	LCD glass chipping.	 Y>T Reject

11.6. Inspection Standard Of Touch Panel

No.	Class	Items		Judgment	
11.6.1	Major	Touch panel crack.			Reject
11.6.2	Minor	Touch panel chipping.	Corner.		X≦1mm, Y≦1mm, Z≦1/2T Accept 1) Corner fragment in the golden finger that seriously affects the product function is regarded as a defect. 2) Corner fragment in the circuit that seriously affects product function is regarded as a defect.
			Edge.		X≦1mm, Y≦1mm, Z≦1/2T Accept 1) Side fragment in the golden finger that seriously affects the product function is regarded as a defect. 2) Side fragment in the circuit that seriously affects product function is regarded as a defect.
11.6.3	Minor	Scratch. Dust and foreign materiel. (linear type)		W≦0.03	Accept
				0.03mm<W≦0.07mm, L≦5.0mm (Distance>5mm)	Accept 2 ea Max.
				W>0.07mm	Reject
11.6.4	Minor	Scratch. Dust and foreign materiel (round type: φ = (length+width)/2)		Φ≦0.2mm	Accept
				0.2mm < Φ≦0.25mm (Distance>5mm)	Accept 1 ea Max.
				Φ > 0.25mm	Reject
11.6.5	Minor	Touch panel dent / fish eyes.		Φ≦0.2mm	Accept
				0.2mm < Φ≦0.5mm (Distance>5mm)	Accept 2 ea Max.
				Φ > 0.5mm	Reject
11.6.6	Minor	Touch panel air bubble.		Φ≦0.2mm	Accept
				0.2mm < Φ≦0.5mm (Distance>5mm)	Accept 2 ea Max.
				Φ > 0.5mm	Reject
11.6.7	Minor	Touch panel printing area scratch.		W≦0.03mm	Accept
				0.03mm < W≦0.05mm, L≦5.0mm (Distance>5mm)	Accept 2 ea Max.
				W > 0.05 (W>0.05 follow 11.6.4 round type)	Reject
11.6.8	Minor	Touch panel white haze mark / dust.		Can not be removed	Reject

12. Handling Precautions

12.1 Mounting Method

The LCD panel of MTUSA 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 (CI), 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 MTUSA 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.