TFT-LCD Module Specification

Module NO.：TST35HV15A

Version：V1.0

☐ **APPROVAL FOR SPECIFICATION**　　　☐ **APPROVAL FOR SAMPLE**

For Customer's Acceptance：

Approved by	Comment

Team Source Display：

Presented by	Reviewed by	Organized by

Version No.	Date	Content	Remark
V1.0	2016-7-6	Initial Release	

CONTENTS

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1   General Characteristics

ITEM	Specification	Unit
LCD Type	a-Si TFT,Transmissive,Normally white,TN	-
LCD Size	3.5	inch
Resolution (W x H)	320 x (RGB) × 480	pixel
LCM (W × H × D)	54.5(W) x 83.0(H) x 2.1(D)	mm
Active Area (W × H)	48.96 (W) x 73.44 (H)	mm
Dot Pitch (W × H)	0.153 x 0.153	mm
Viewing Direction	6 o'clock	-
Gray Scale Inversion Direction	12 o'clock	-
Viewing Angle	Top:25,Bottom:50; Left/ Right:60	deg.
Color Depth	65K/262K	-
Pixel Arrangement	RGB-stripe	-
Backlight Type	6 LEDs	-
Surface Luminance	285	cd/m2
Surface Treatment	Anti-Glare	-
Polarizer	0.22mm,EWV	-
Driver IC	HX8357D	-
Interface Type	MCU 8/16-bit	-
Input Voltage	2.8~3.3V	V
With/Without TP	without	-
Weight	TBD.	g

Note 1: RoHS compliant
**Note 2: LCM weight tolerance: ± 5%.**

2 Product drawings

GENERAL TOLERANCE±0.2

LCD Type	3.5"TFT, Transmissive, Normally white,TN	
Resolution	320(RGB)*480	
View Direction	6 OCLOCK	
Driver IC	HX8357-D	
Color Depth	65K/262K	
Interface Types	MCU8/16-bit	
Operating voltage	2.8V~3.3V	
With/without TP	Without	
Backlight LEDs	6 LEDs, 120mA,3.2V	
Surface luminance	285 cd/m2	
Operating temperature	20 ℃ ~70 ℃	
Storage Temperature	-30 ℃ ~80 ℃	
Storage Humidity	10RH ~ 40RH	

BACKLIGHT CIRCUIT DIAGRAM

IM0=0，MCU16-bit，DB0~DB15；
IM0=1，MCU8-bit，DB0~DB7；

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DONG GUAN TEAM SOURCE DISPLAY TECH. CO. LTD.

PIN	DESCRIPTION
1	GND
2	GND
3	IM0(8/16)
4	FMARK
5	YD/NC
6	XL/NC
7	RESET
8	RS
9	CS
10	RD
11	WR
12	VCC
13	NC
14	GND
15	DB15
16	DB14
17	DB13
18	DB12
19	DB11
20	DB10
21	DB9
22	DB8
23	DB7
24	DB6
25	DB0
26	DB1
27	DB2
28	DB3
29	DB4
30	DB5
31	YU/NC
32	XR/NC
33	LEDA
34	LEDK1
35	LEDK2
36	LEDK3
37	LEDK4
38	LEDK5
39	LEDK6
40	GND

3 Interface description

| PIN NO.	Symbol	description
1	GND	System Ground. (0V)
2	GND	System Ground. (0V)
3	IM0	IM0=0: MCU16-BIT, DB0~DB15 IM0=1: MCU8-BIT, DB0~DB7
4	FMARK	Tearing Effect output signal
5	NC	
6	NC	
7	RESET	Reset input signal
8	RS	Data/Command Selection pin
9	CS	Chip select signal.
10	RD	read signal
11	WR	serves as a write signal
12	VCC	Power supply +2.8V
13	NC	
14	GND	System Ground. (0V)
15~24	DB15~DB6	Data BUS
25~30	DB0~DB5	Data BUS
31	NC	
32	NC	
33	LEDA	Backlight A Aothod input pin.
34~39	LEDK1~LEDK6	Backlight K Cathode input pin.
40	GND	System Ground. (0V)

4 LCM Interface Timing

4.1 Reset Timing
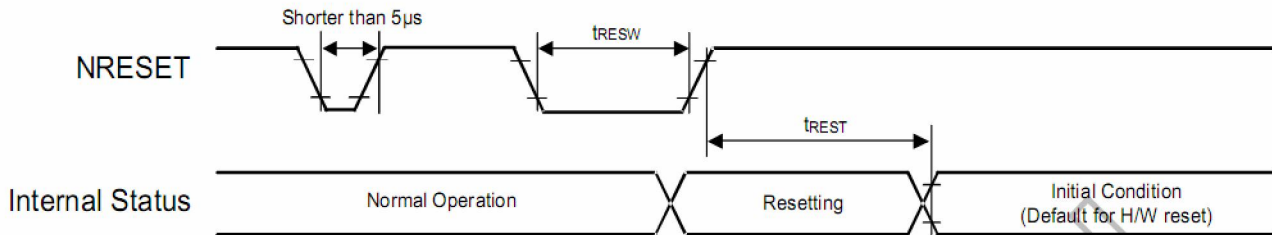
Signal	Symbol	Parameter	Min	Max	Unit
NRESET	tRESW	Reset low pulse width	10	-	us
	tREST	Reset complete time	5 (note 1)	-	ms
			120(note 2)	-	ms

Note: (1) When reset applied during SLPIN mode;

(2) When reset applied during SLPOUT mode.

4.2 MCU Read/Write Timing
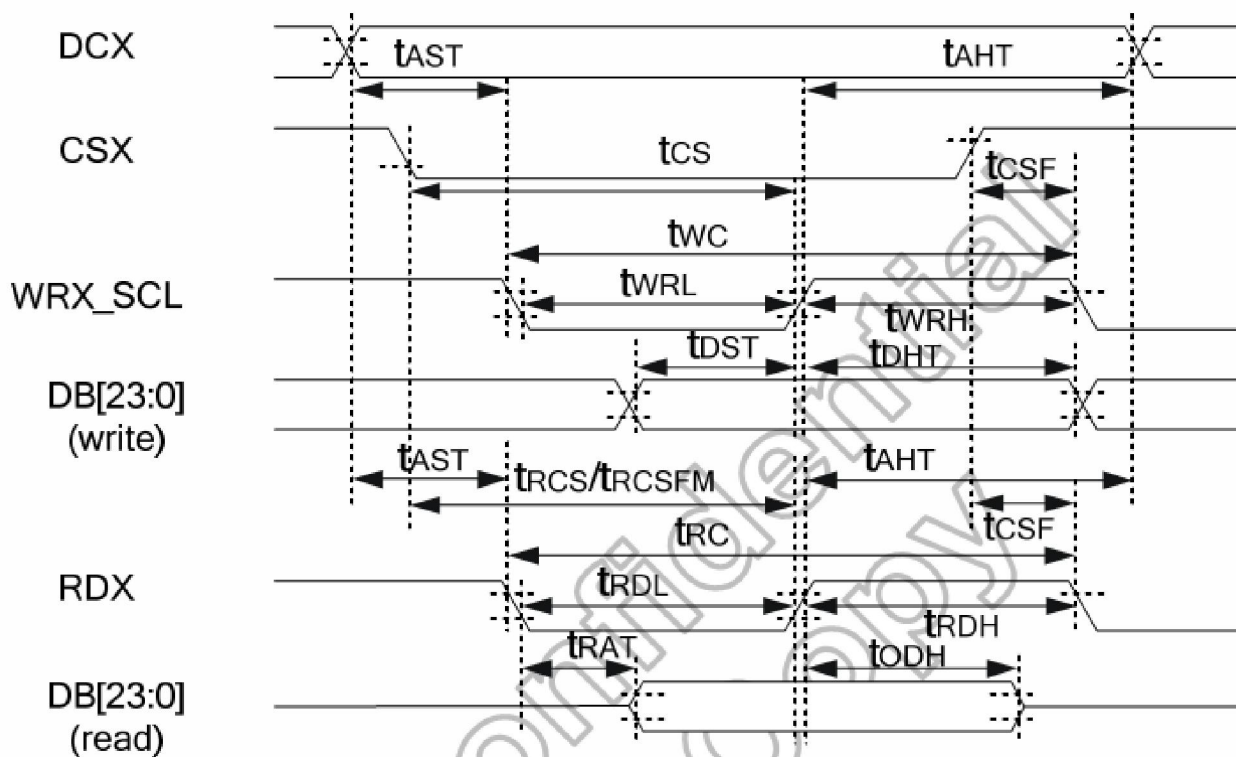
(VSSA=0V, VDD1=1.8V, VDD3=2.8V, TA=25°C)

Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tAST	Address setup time	0	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-		
CSX	tCS	Chip select setup time (Write)	10	-	ns	-
	tRCS	Chip select setup time (Read register)	45	-		
	tRCSFM	Chip select setup time (GRAM)	355	-		
	tCSF	Chip select wait time (Write/Read)	10	-		
WRX_SCL	tWC	Write cycle (write register)	50	-	ns	-
	tWC	Write cycle (write GRAM@SLPOUT)	47	-		
	tWC	Write cycle (write GRAM@SLPIN)	100	-		
	tWRH	Control pulse "H" duration	15	-		
	tWRL	Control pulse "L" duration	15	-		
RDX	tRC	Read cycle (read register)	160	-	ns	-
	tRC	Read cycle (GRAM)	450	-		
	tRDH	Control pulse "H" duration	90	-		
	tRDL	Control pulse "L" duration(read register)	35	-		
	tRDL	Control pulse "L" duration(GRAM)	345	-		
DB[23:0]	tDST	Data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10	-		
	tRAT	Read access time(read register)	-	40		
	tRAT	Read access time(GRAM)	-	340		
	tODH	Output disable time	20	80		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.
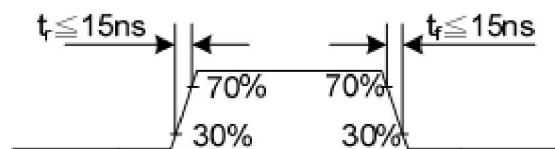
5 INITIAL CODE

LCD_REST=0;// Hardware reset
Delayms(15);
LCD_REST=1;
Delayms(120);

write_reg(0xB9);   //SET password
write_dat(0xFF);
write_dat(0x83);
write_dat(0x57);

```
write_reg(0xB1);        //SETPower
write_dat(0x00);        //STB
write_dat(0x11);        //VGH = 15V, VGL = -10V
write_dat(0x1E);        //VSPR = 4.5V
write_dat(0x1E);        //VSNR = -4.5V
write_dat(0xC3);        //AP
write_dat(0x77);        //FS

write_reg(0xB4);        //SETCYC
write_dat(0x11);        //1-dot
write_dat(0x40);        //RTN
write_dat(0x00);        //DIV
write_dat(0x2A);        //N_DUM
write_dat(0x2A);        //I_DUM
write_dat(0x20);        //GDON
write_dat(0x78);        //GDOFF

write_reg(0xB6);        //VCOMDC
write_dat(0x33);

write_reg(0xC0);        //SETSTBA
write_dat(0x70);        //N_OPON
write_dat(0x70);        //I_OPON
write_dat(0x00);        //STBA
write_dat(0x3C);        //STBA
write_dat(0xC4);        //STBA
write_dat(0x08);        //GENON

write_reg(0xC2);        // Set Gate EQ
write_dat(0x00);
write_dat(0x08);
write_dat(0x04);

write_reg(0xCC);        //Set Panel
write_dat(0x09);        //SS_Panel = 1, BGR_Panel = 1

write_reg(0xE0);        //Set Gamma
write_dat(0x00);        //VRP0
write_dat(0x05);        //VRP1
write_dat(0x12);        //VRP2
write_dat(0x21);        //VRP3
write_dat(0x2C);        //VRP4
write_dat(0x40);        //VRP5
write_dat(0x4B);        //VRP6
```

```
write_dat(0x52);        //VRP7
write_dat(0x47);        //VRP8
write_dat(0x41);        //VRP9
write_dat(0x3A);        //VRP10
write_dat(0x31);        //VRP11
write_dat(0x2E);        //VRP12
write_dat(0x29);        //VRP13
write_dat(0x24);        //VRP14
write_dat(0x00);        //VRP15
write_dat(0x00);        //VRN0
write_dat(0x05);        //VRN1
write_dat(0x12);        //VRN2
write_dat(0x21);        //VRN3
write_dat(0x2C);        //VRN4
write_dat(0x40);        //VRN5
write_dat(0x4B);        //VRN6
write_dat(0x52);        //VRN7
write_dat(0x47);        //VRN8
write_dat(0x41);        //VRN9
write_dat(0x3A);        //VRN10
write_dat(0x31);        //VRN11
write_dat(0x2E);        //VRN12
write_dat(0x29);        //VRN13
write_dat(0x24);        //VRN14
write_dat(0x00);        //VRN15
write_dat(0x00);
write_dat(0x01);        //GMA_Reload

write_reg(0x3A);        //COLMOD
write_dat(0x55);        //RGB565
write_reg(0x11);        //Sleep Out
Delayms(150);
write_reg(0x29);        //Display On
```

6   Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Analog)	VCC~GND	-0.3	4.6	V
Logic signal voltage(I/O)	IOVCC~GND	-0.3	4.6	V
Operating Temperature	TOP	-20	70	° C
Storage Temperature	TST	-30	80	° C
Humidity	RH	-	90%(Max 60° C)	RH

7   Electrical   Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Analog operating voltage	VCC	2.5	2.8	3.3	V
Logic operating voltage	IOVCC	1.65	1.8	3.3	V
Input Current	IDD	-	TBD	-	mA
Input Voltage ' H ' level	VIH	0.7IOVCC	-	IOVCC	V
Input Voltage ' L ' level	VIL	GND	-	0.3IOVCC	
Output Voltage ' H ' level	VOH	0.8IOVCC	-	IOVCC	
Output Voltage ' L ' level	VOL	GND	-	0.2IOVCC	

8   Backlight   Characteristics

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V_f	-	3.2	3.4	V
Current for LED backlight	I_f	-	120	-	mA
Power consumption	Wbl	-	384	-	mW
Uniformity	Avg	80	-	-	%
LED Life Time	-	30000	40000	-	Hrs

Note:

1.The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C, 60%RH ±5 %.

2. The life time of LED will be reduced if LED is driven by high current, high ambient temperature and humidity conditions.

3. Typical operating life time is an estimated data.

4. Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded .Functional operation should be restricted to the conditions described under normal operating conditions.

9 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min	Typ	Max		
Response time (By Quick)	Tr+Tf	θ = 0°	-	20	40	ms	Note 5
Contrast ratio	CR	θ = 0°	-	500	-		Note 2,6
Viewing angle	Top	CR≧10	-	25	-	Deg.	Note 2,6,7
	Bottom	CR≧10	-	50	-		
	Left	CR≧10	-	60	-		
	Right	CR≧10	-	60	-		
Color chromaticity (CF only with ITO, light source is C light, CIE 1931)	Wx	θ = 0°	0.292	0.307	0.322		Note 3
	Wy		0.312	0.327	0.342		
	Rx		0.609	0.624	0.639		
	Ry		0.316	0.331	0.346		
	Gx		0.281	0.296	0.311		
	Gy		0.562	0.577	0.592		
	Bx		0.128	0.143	0.158		
	By		0.094	0.109	0.124		
NTSC			57%	60%	-		Note 3
Cross talk	Ct		-	-	2%		Note 9
Transmittance	Trans			5.5%	-		Note 4

Note 1: Ambient temperature = 25°C.

Note 2: To be measured with a viewing cone of 2°by Topcon luminance meter BM-5A.

Note 3: To be measured with Otsuta chromaticity meter LCF-2100M, CF only measure under C light simulation.

Note 4: CTC shipping status is cell without polarizer. Transmittance of Specification is cell with polarizer. The tolerance of Transmittance is ±10%.

Note 5: Definition of response time:

The output signals of TRD-100 are measured when the input signals are changed to "White" (falling time) and from "White" to "Black" (rising time), respectively. The interval is between the 10% and 90% of amplitudes. Refer to figure as below.
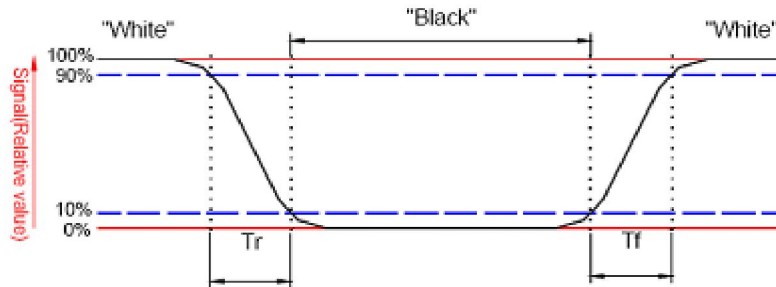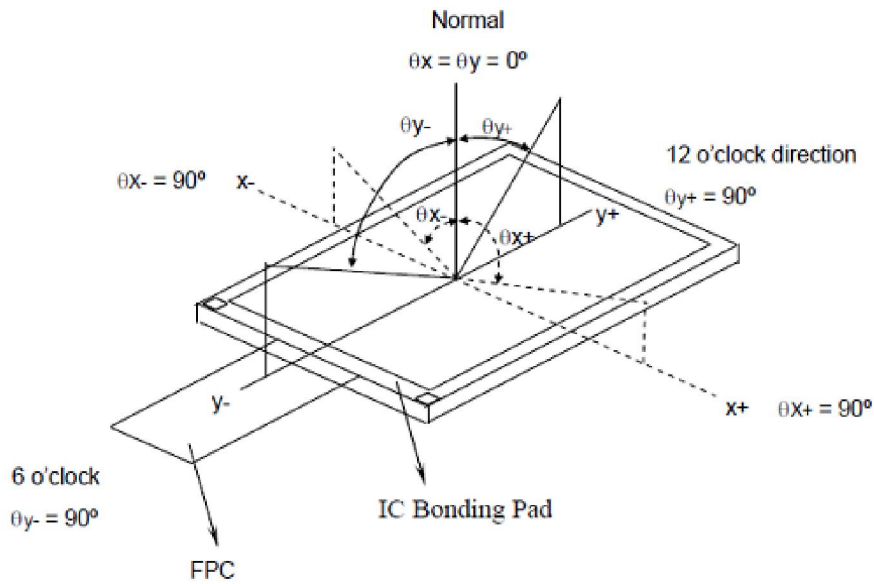

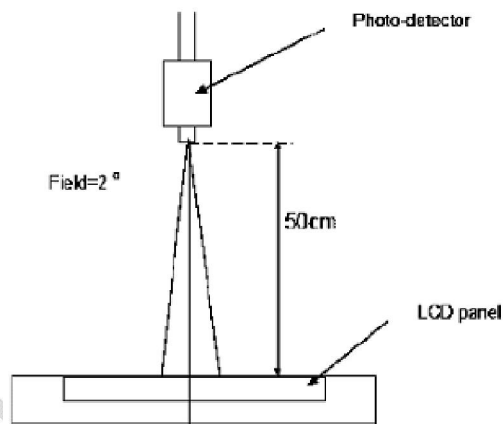
Note 6: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$
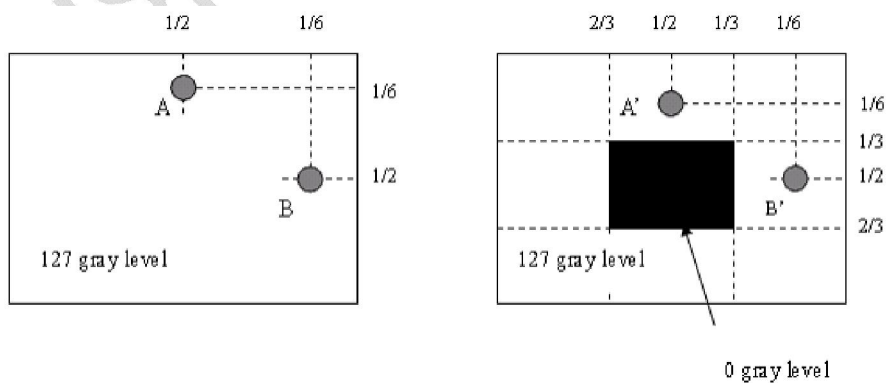
Note 7: Definition of viewing angle

Note 8: Optical characteristic measurement setup.

Note 9:

l LA-LA' l / LA x 100%= 2% max., LA and LA' are brightness at location A and A'.
l LB-LB' l / LB x 100%= 2% max., LB and LB' are brightness at location B and B'.

10 RELIABILITY TEST

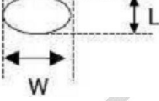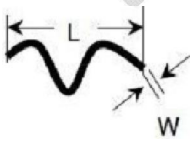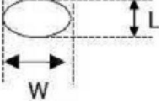| NO.	TEST ITEM	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	80±2°C/96 hours	
2	Low Temperature Storage	-30±2°C/96 hours	
3	High Temperature Operating	70±2°C/96 hours	
4	Low Temperature Operating	-20±2°C/96 hours	Inspection after 2~4 hours storage at room temperature and humidity. The condensation is not accepted. The sample shall be free from defects:
5	Temperature Cycle	-30±2°C ~ 25~ 80± 2°C × 10 cycles (30 min.)　(5min.)　　(30min.)	
6	Damp Proof Test	60°C ±5°C × 90%RH/96 hours	
7	Vibration Test	Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z	1.　Air bubble in the LCD 2.　Seal leak 3.　Non-display 4.　Missing segments 5.　Glass crack
8	Shock Test	Half-sine, wave, 300m/s	
9	Packing Drop Test	Height: 80 cm 1 corner, concrete floor	
10	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	

11 Inspection standards

11.1 Visual inspection criterion in cosmetic

11.1.1 Glass defect

NO.	Defect	Criteria	Remark
1	Dimension(Minor)	By engineering diagram	
2	Cracks(Major)	Extensive crack [Reject]	

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11.1.2 LCM appearance defect

NO.	Defect	Criteria		Remark
		Spec	Permissible Qty	
1	Round type(Minor)	$\phi \leq 0.1mm$	Disregard	1. $\phi =(W+L)/2$, L:Length,W=Width 2.Disregard if out of A.A
		$0.1mm< \phi \leq 0.2mm$	3	
		$\phi >0.2mm$	0	
2	Line type(Minor)	$W \leq 0.03mm$	Disregard	1. L:Length,W=Width 2.Disregard if out of A.A
		$L\leq 3.0mm$ and $0.03mm<W\leq0.05mm$	2	
		$L\leq 3.0mm$ and $0.05mm<W\leq0.1mm$	1	
		$W>0.10mm$ or $L>3.0mm$	0	
3	Polarizer dent(Minor)	$\phi \leq 0.2mm$	Disregard	1. $\phi =(W+L)/2$, L:Length,W=Width 2.Disregard if out of A.A
		$0.2mm< \phi \leq 0.3mm$	2	
		$0.3mm< \phi \leq 0.5mm$	1	
		$\phi >0.5mm$	0	

11.1.3 FPC

NO.	Defect	Criteria	Remark
1	Copper peeling(Minor)	Copper peeling [Reject]	
2	Damaged	Damaged[Reject]	
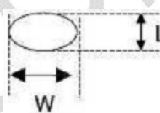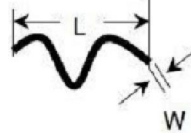
11.1.4 Black tape

NO.	Defect	Criteria	Remark
1	Shift(Minor)	IC exposed [Reject]	
2	No black tape(Minor)	No black tape [Reject]	

11.1.5 Silicon

NO.	Defect	Criteria	Remark
1	Amount of silicon (Minor)	ITO exposed [Reject]	

11.2 Visual inspection criterion in electrical display

NO.	Defect	Criteria		Remark
		Spec.	Permissible Qty	
1	No display (Major)	Not allowed		
2	Missing line (Major)	Not allowed		
3	Darker or lighter Line (Major)	Not allowed		
4	Weak line(Major)	By limited sample		
5	Bright / Dark point (Minor)	Bright point	1	1:1sub-pixel: 1R or 1G or 1B 2:Point defect area 1/2 sub pixel.
		Dark point	2	
6	Round type (Minor)	Φ≤0.1mm	Disregard	1. Φ=(W+L)/2, L:Length,W=Width 2.Disregard if out of A.A
		0.1＜Φ≤0.2	3	
		Φ＞0.2mm	0	
	Line type (Minor)	W ≤0.03mm	Disregard	1. L:Length,W=Width 2.Disregard if out of A.A
		L≤ 3.0mm and 0.03mm＜W≤0.05mm	2	
		L≤ 3.0mm and 0.05mm＜W≤0.1mm	1	
		W＞0.10mm or L＞3.0mm	0	
	Mura (Minor)	By 5% ND filter invisible		

11.3 Others

1. Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)

2. Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)

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12 Suggestions for using LCD modules

12.1 Handling of LCM

1. The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.

2. If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.

3. Don't apply excessive force on the surface of the LCM.

4. If the surface is contaminated, clean it with soft cloth. If the LCM is severely contaminated, use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer. The   following solvents is especially prohibited: water , ketone Aromatic solvents etc.

5. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

6. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping   and   distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

7. Don't disassemble the LCM.

8. To prevent destruction of the elements by static electricity, be careful   to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded.

- To   reduce   the amount of static electricity generated, do not conduct assembling and other work under dry conditions.

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

9. Do not alter, modify or change the the shape of the tab on the metal frame.

10. Do not make extra holes on the printed circuit board, modify its   shape   or   change the positions   of components to be attached.

11. Do not damage or modify the pattern writing on the printed circuit board.

12. Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector

13. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

14. Do not drop, bend or twist LCM.

12.2 Storage

1. Store in an ambient temperature of 5 to 45   C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.

2. Storage in a clean environment, free from dust, active gas, and solvent.

3. Store in antistatic container.