

**PRODUCT SPECIFICATION****TFT-LCD MODULE****Module No: 100283-01**☒ Preliminary Specification☐ Approval Specification

Designed by	Checked by	Approved by

Final Approval by Customer

Approved by	Comment

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※The specification of "TBD" should refer to the measured value of sample . If there is difference between the design specification and measured value, we naturally shall negotiate and agree to solution with customer.

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1.Document Revision History

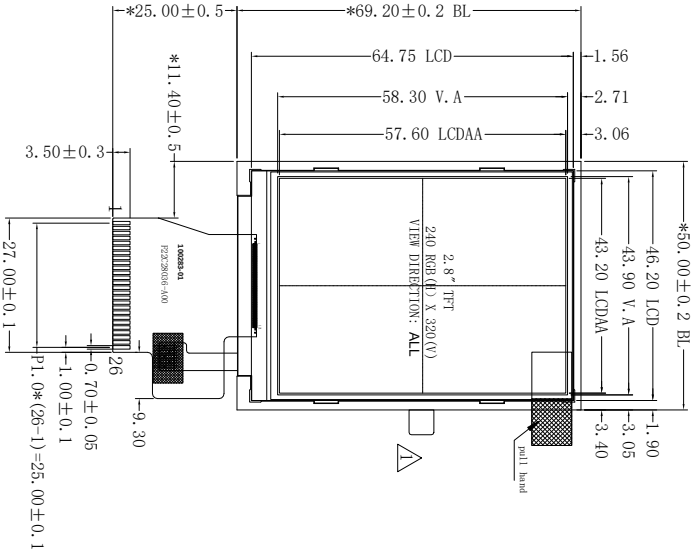
Version	Contents	Date	Note
V0	NEW	2022.05.24	
V1	Change the tearing position	2023.03.09	

2.GENERAL INFORMATION

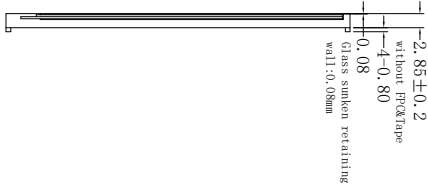
N0	Item	Specification	Unit	Remark
1	LCD Size	2.8	inch	-
2	Panel Type	IPS	-	-
4	Resolution	240*RGBX320	pixel	-
5	Display Mode	Normally black	-	-
6	Number of Colors	262K	-	-
7	Viewing Direction	ALL O'CLOCK	-	-
8	NTSC	60%	-	TYP
9	Contrast Ratio	800	-	TYP
10	Luminance	500	nit	TYP
11	Module Size	50.00(W) x69.20(H) x2.85(T)	mm	Note
12	Panel Active Area	43.20(H) × 57.60(V)	mm	Note
13	Pixel Pitch	0.180(H)x 0.180(V)	mm	-
14	Weight	NA	g	-
15	Driver IC	ST7789V2	-	-
16	Driver IC RAM Size	RAMLESS	bit	-
17	Light Source	4 white LED in 1S4P	-	-
18	Interface	8bit MCU interface	-	-
19	Operating Temperature	-20~+70	℃	-
20	Storage Temperature	-30~+80	℃	-

3.Outline Dimension

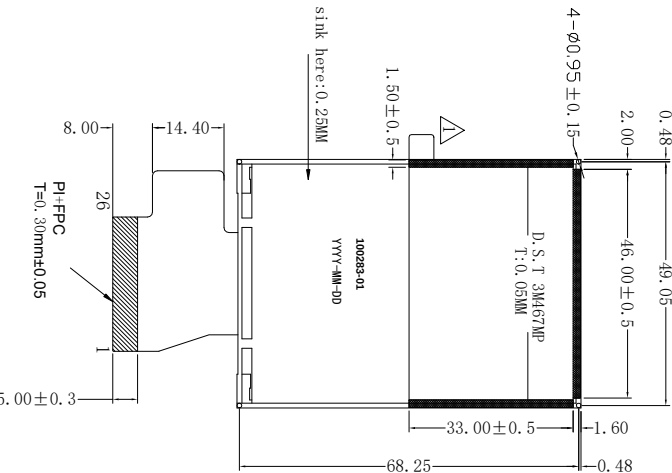
Front View



Side View



Back View

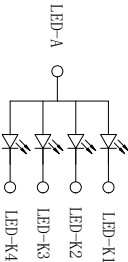


NO.	Pin Name
1	GND
2	CS
3	RS
4	WR
5	RD
6	NC
7	NC
8	NC
9	NC
10	LEDA
11	LEDK1
12	LEDK2
13	LEDK3
14	LEDK4
15	DB8
16	DB9
17	DB10
18	DB11
19	DB12
20	DB13
21	DB14
22	DB15
23	RES
24	VCC
25	VCC
26	GND

FPC starts shipping

Notes:

1. Display : 2.8", QVGA TFT
2. Resolution: 240xRGBx320
3. View Direction: ALL
4. LCD Driver: S17789V2
5. Luminance: 500/cdm² (TYP)
6. *:Critical dimension () : Reference dimension;
7. Undefinition Tolerance: ±0.2
8. OPERATING TEMP: -20° C ~ +70° C
9. STORAGE TEMP: -30° C ~ +80° C
10. Requirements on Environmental Protection: ROHS



3	Change the tearing position	2023.03.09	NAME
2	NEW	2022.05.24	NAME
1	REV	DATE	NAME

SCALE: 1/1	UNIT: mm	PAGE: 1/1	Approve	Check	Drawn
Part No:	100283-01	VER: V1			
Customer No:				JK	

4. Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit
LCM Operating Temperature	T _{OPR}	-20	+70	°C
LCM Storage Temperature	T _{STG}	-30	+80	°C
Humidity	RH	10	90	%

5. Electrical Characteristics

5.1 TFT DC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage for analog	V _{CC}	2.5	2.8	3.6	V
Supply voltage for I/O interface	IOV _{CC}	1.65	—	3.6	V
Input voltage 'H' level	V _{IH}	0.7*IOV _{CC}	—	IOV _{CC}	V
Input voltage 'L' level	V _{IL}	0	—	0.3*IOV _{CC}	V
Output voltage 'H' level	V _{OH}	0.8*IOV _{CC}	—	IOV _{CC}	V
Output voltage 'L' level	V _{OL}	0	—	0.2*IOV _{CC}	V

5.2 Back-Light Unit Characteristics

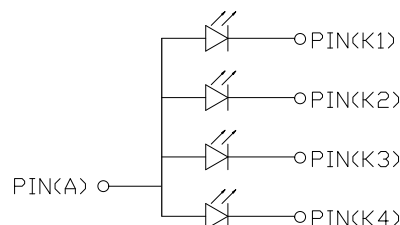
The back-light system is an edge-lighting type with 6 white LEDs. The characteristics of the back-light are shown in the following tables.

Characteristics	Symbol	Min.	Type	Max.	Unit	Notes
Forward Voltage	V _F	2.9	3.2	3.4	V	-
Forward current	I _F	--	80	--	mA	-
Luminance(With LCD)	L _v	--	500	--	cd/m ²	-
LED life time	N/A	--	50,000	--	Hr	Note 1

Note:

- (1) The “LED life time” is defined as the module brightness decrease to 50% of original brightness at I_F=30mA/LED. The LED life time could be decreased if operating I_F is larger than 45mA/LED.

Backlight circuit diagram shown in below:



6. INTERFACE DESCRIPTION

Pin No.	Symbol	I/O/P	Description
1	GND	P	Power ground.
2	/CS	I	Chip select signal.
3	RS	I	Display data/command selection pin.
4	/WR	I	Write enable signal.
5	/RD	I	Read enable signal.
6	NC(XR)	-	No connection.
7	NC(YD)	-	No connection.
8	NC(XL)	-	No connection.
9	NC(YU)	-	No connection.
10	LEDA	P	Anode of LED backlight.
11	LEDK1	P	Cathode of LED backlight.
12	LEDK2	P	Cathode of LED backlight.
13	LEDK3	P	Cathode of LED backlight.
14	LEDK4	P	Cathode of LED backlight.
15	DB8	I/O	Data bus.
16	DB9	I/O	Data bus.
17	DB10	I/O	Data bus.
18	DB11	I/O	Data bus.
19	DB12	I/O	Data bus.
20	DB13	I/O	Data bus.
21	DB14	I/O	Data bus.
22	DB15	I/O	Data bus.
23	RES	I	Reset pin, active low.
24	VCC	P	Power supply.
25	VCC	P	Power supply.
26	GND	P	Power ground.

Note: I/O/P definition: I----Input O----Output P----Power/Ground

7.0 AC Characteristics

7.1.1 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

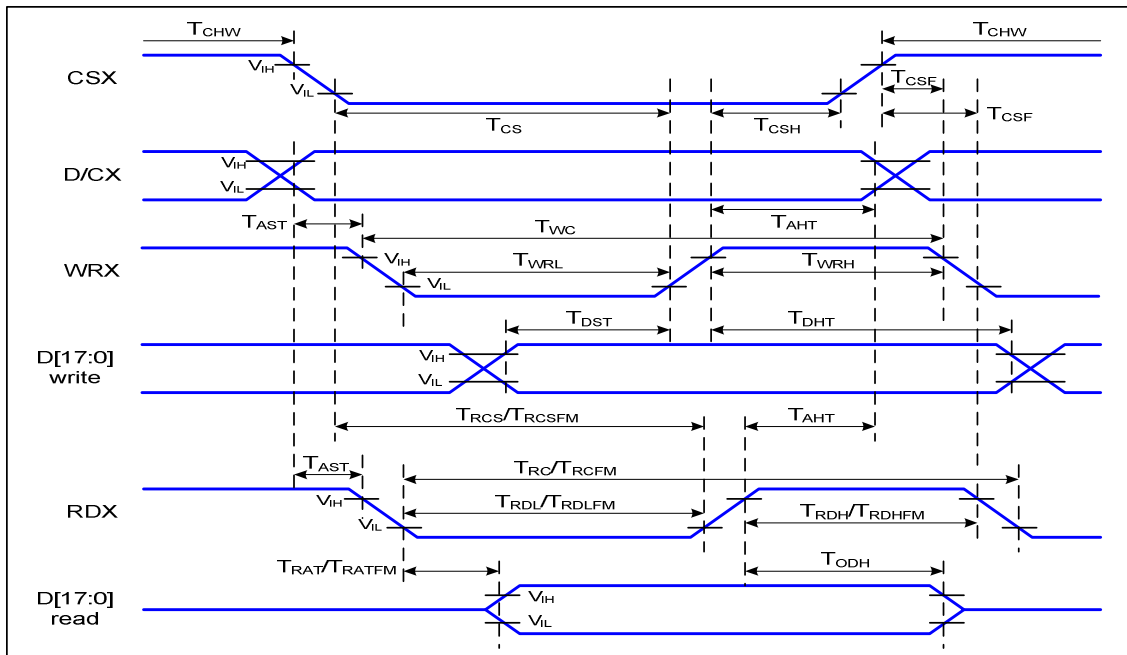


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 °C

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T _{AST}	Address setup time	0		ns	-
	T _{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T _{CHW}	Chip select "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	
	T _{CSF}	Chip select wait time (Write/Read)	10		ns	
	T _{CSH}	Chip select hold time	10		ns	
WRX	T _{WC}	Write cycle	66		ns	
	T _{WRH}	Control pulse "H" duration	15		ns	
	T _{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T _{RC}	Read cycle (ID)	160		ns	When read ID data
	T _{RDH}	Control pulse "H" duration (ID)	90		ns	
	T _{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T _{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T _{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T _{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T _{DST}	Data setup time	10		ns	For CL=30pF

	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)		40	ns	
	T_{RATFM}	Read access time (FM)		340	ns	
	T_{ODH}	Output disable time	20	80	ns	

Table 4 8080 Parallel Interface Characteristics

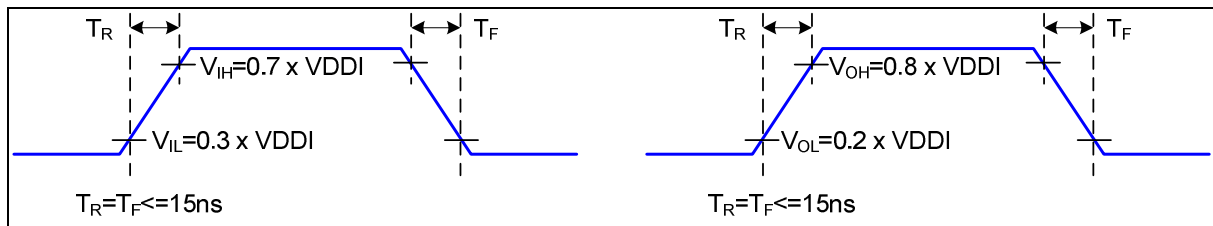


Figure 2 Rising and Falling Timing for I/O Signal

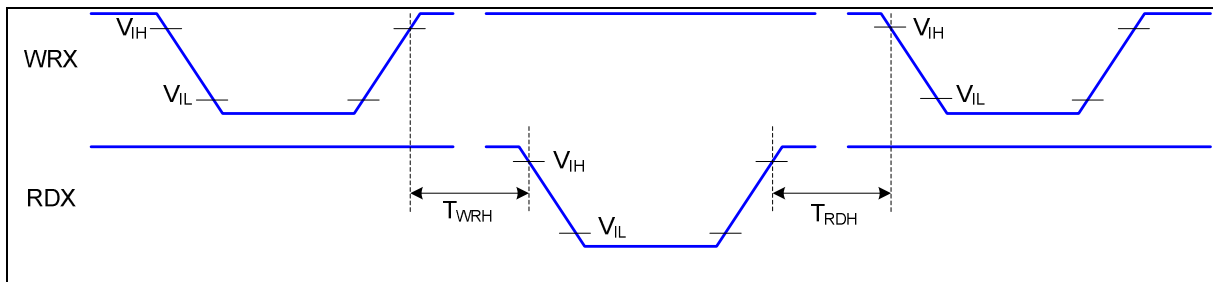


Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (T_R , T_F) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of V_{DDI} for Input signals.

7.1.2. Reset Timing:

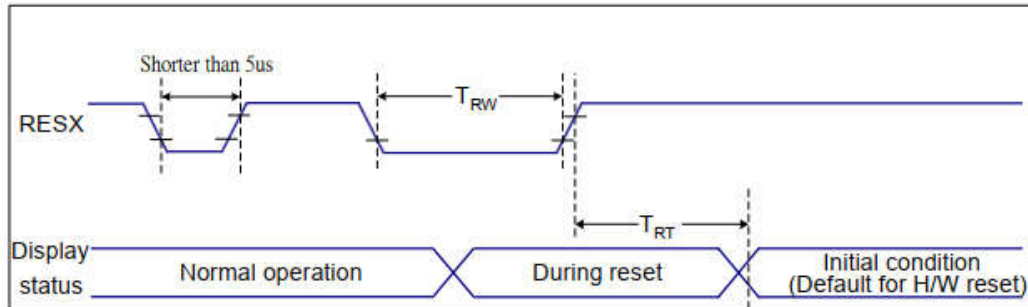


Figure 7 Reset Timing

$VDDI=1.65$ to $3.3V$, $VDD=2.4$ to $3.3V$, $AGND=DGND=0V$, $Ta=25^{\circ}C$

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

Table 9 Reset Timing

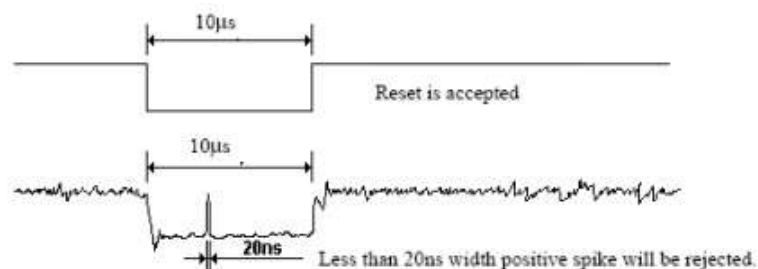
Notes:

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 (t_{RT}) 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.

8.ELECTRO-OPTICAL CHARACTERISTICS

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Notes
Response Time		Tr + Tf	$\theta=0^{\circ}$	-	30	40	ms	FIG 1, 2	4
Contrast Ratio		Cr		600	800	-	---	FIG 1, 3	1
Luminance Uniformity		δ White		80	-	-	%	FIG 1, 3	3
Surface Luminance		Lv		400	500	-	cd/m ²	FIG 1, 3	2
Viewing Angle Range		θ	$\varnothing = 90^{\circ}$	80	-	-	deg	FIG 1, 4	1, 6
			$\varnothing = 270^{\circ}$	80	-	-	deg		
			$\varnothing = 0^{\circ}$	80	-	-	deg		
			$\varnothing = 180^{\circ}$	80	-	-	deg		
CIE (x,y) Chromaticity	Red	x	$\theta=0^{\circ}$	0.578	0.628	0.678	---	FIG 1, 3	5
		y		0.291	0.341	0.391			
	Green	x		0.265	0.315	0.365			
		y		0.560	0.610	0.660			
	Blue	x		0.093	0.143	0.193			
		y		0.021	0.071	0.121			
	White	x		0.256	0.306	0.356			
		y		0.291	0.341	0.391			
NTSC		-	-	-	67.9	-	%	-	-

Note 1. Contrast Ratio (CR) is defined by following formula. For more information see FIG 3.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

Note 2. Surface luminance is the LCD surface luminance with all pixels displaying white state. For more information see FIG 3.

$$Lv = \text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}$$

Note 3. The uniformity in surface luminance (δ White) is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 3.

$$\delta \text{ White} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 4. Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Fall Time, Tf). For additional information see FIG 2.

Note 5. CIE (x,y) chromaticity, color coordinates measured at center point of LCD.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than a specific value. For TFT module the contrast ratio is greater than 10. The monochrome LCD, the specific value of contrast ratio is 2. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

Note 7. For viewing angle and response time testing, the testing data is based on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface luminance, Luminance uniformity, and CIE, the test data is based on TOPCON's BM-5 photo detector.

FIG 1. The setup of optical measurement.

The optical characteristics should be measured in a stable, windless, and dark room.

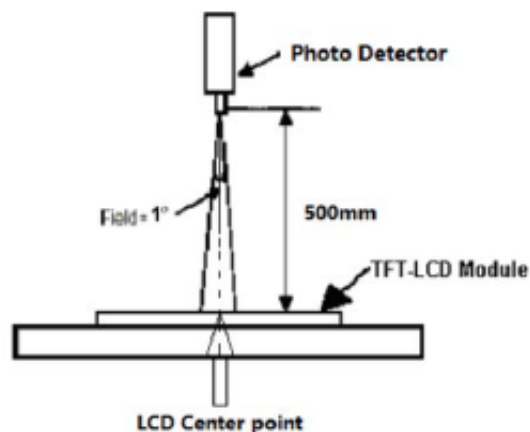


FIG 2. The Definition of Response Time

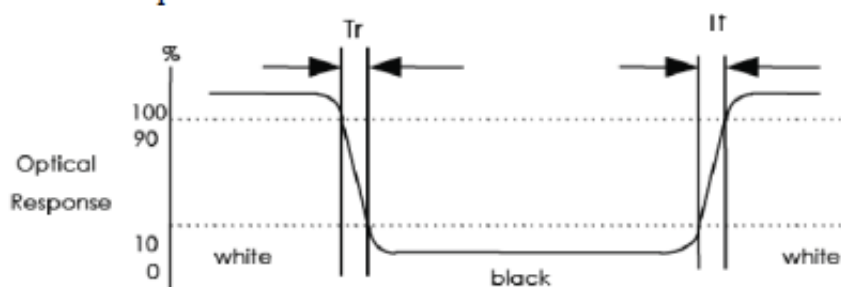
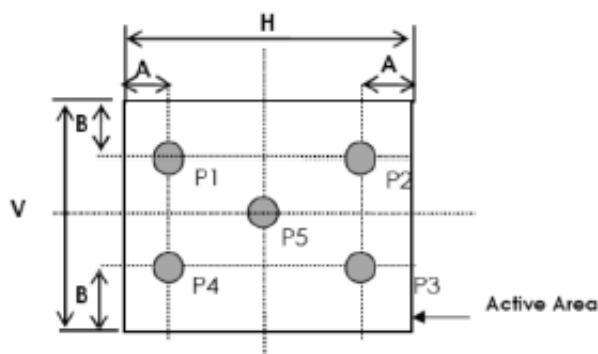


FIG 3. Measuring method for contrast ratio, surface luminance, Luminance uniformity, CIE (x,y) chromaticity.



A: $H/6$

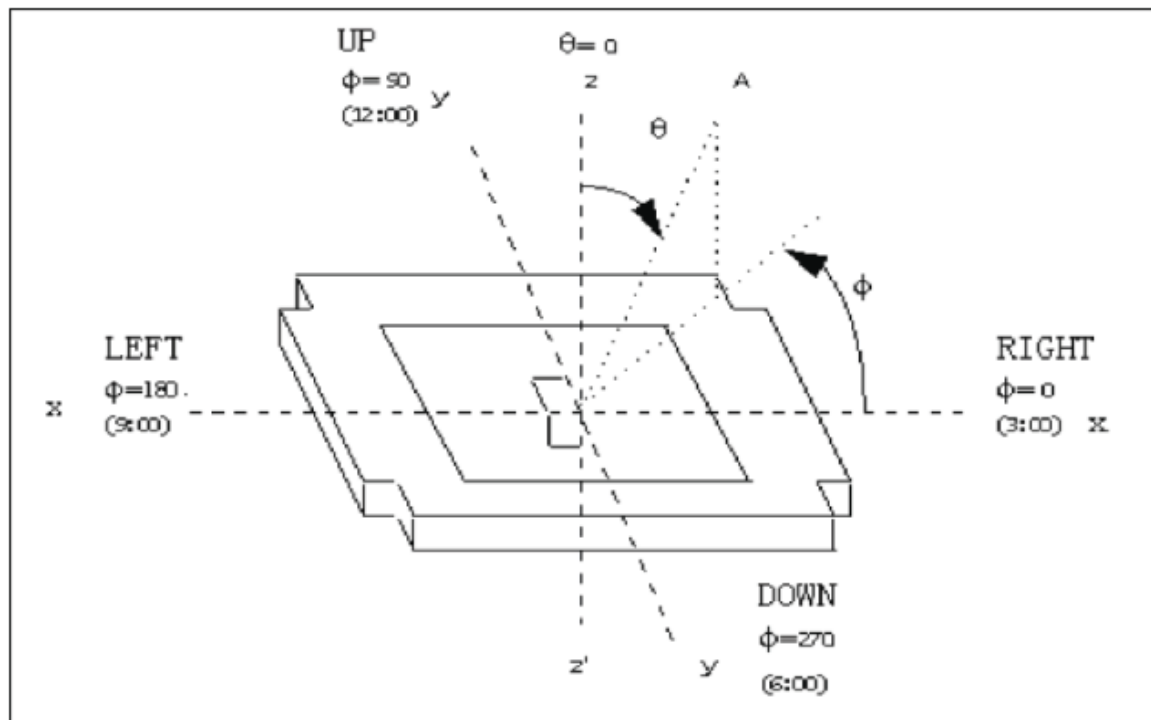
B: $V/6$

H, V: Active Area

Light spot size $\varnothing = 7\text{mm}$, 500mm distance from the LCD surface to detector lens.

Measurement instrument is TOPCON's luminance meter BM-5.

FIG 4. The definition of viewing angle



9. Reliability Test Item

No.	Test Item	Test Condition	Notes
1	High Temp. Storage	+80°C / 96H	1. Functional test is OK. Missing Segment, short, unclear segment non-display, display abnormally and liquid crystal leakage are un-allowed. 2. No low temperature bubbles, end seal loose and fall, frame rainbow.
2	Low Temp. Storage	-30°C / 96H	
3	High Temp. Operating	+70°C / 96H	
4	Low Temp. Operating	-20°C / 96H	
5	High Temperature / Humidity storage	50°C x 90%RH / 96H	
6	Thermal and cold shock	Static state, -20°C (30min) ~ 60°C (30min), 50 cycles	

10. Inspection standards

10.1 AQL (Acceptable Quality Level)

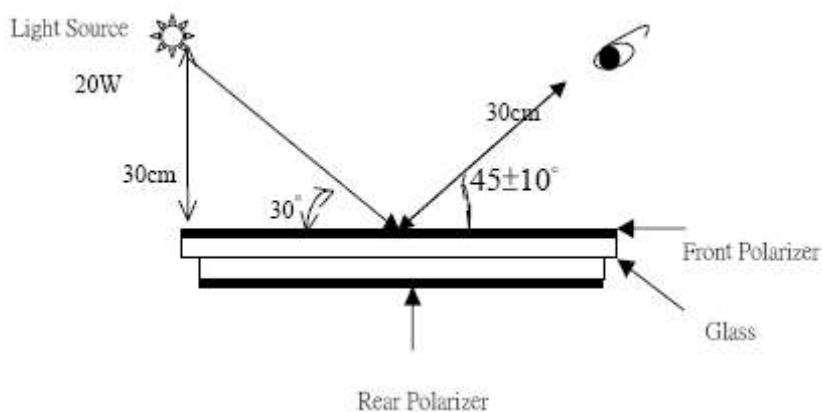
AQL of major and minor defect.

	MAJOR DEFECT	MINOR DEFECT
AQL	1.0	1.5

10.2 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 30 cm with an angle of 45 degree to check the products without uncovering the film!

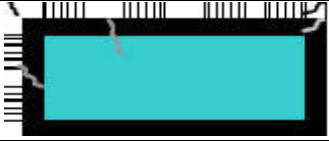
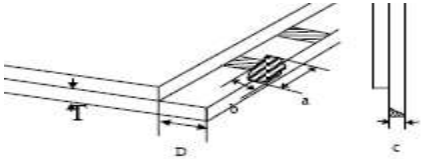
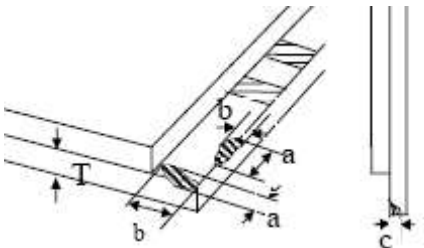
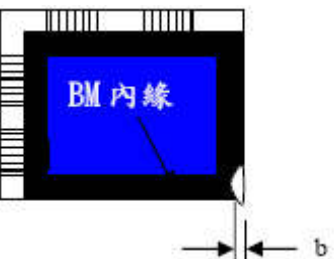
(As shown below)



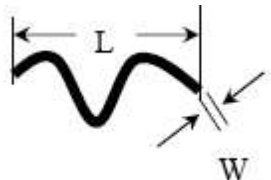
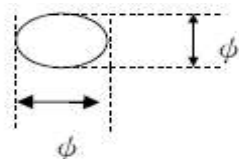
10.3 Inspection item and criteria

10.3.1 Visual inspection criterion in immobility

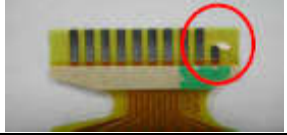
10.3.1.1 Glass defect

N O	Defect item	Criteria	Remark
1	Dimension Unconformity (Major defect)	By Engineering Drawing	
2	Cracks (Major defect)	1. Linear cracks 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 $\leq 0.5\text{mm}$ 【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 (Including contraposition mark, except scribing mark) 【Accept】 2) $C < T$ $b \leq BM/3$ of width 【Accept】 3) $c = T$ b not touch the seal glue 【Accept】 4) a disregards	a: Length, b: Width c: Thickness 
6	Non-pin-side damage (minor defect)	$c < T$ 1) b exceeds $1/3 BM$ 【Reject】 $c = T$ b not touch the seal glue 【Reject】	c: Thickness b: width of damage 

10.3.1.2 LCD appearance defect(View area)

NO	Defect item	Criteria		Remark
1	Fiber 、glass cratch 、polarizer scratch/folded (minor defect)	Specification	Allowable	note1:L: Length, W: Width note2: disregard if out of AA 
		$W \leq 0.03\text{mm}$	disregard	
		$0.03\text{mm} < W \leq 0.05\text{mm};$ $L \leq 4.0\text{mm}$	2	
		$0.05\text{mm} < W \leq 0.1\text{mm};$ $L \leq 4.0\text{mm}$	1	
		$W > 0.1\text{mm}; L > 4.0\text{mm}$	0	
2	Polarizer bubble 、 concave and convex (minor defect)	$\varphi \leq 0.2\text{mm}$	disregard	note1: φ $= (L+W)/2$, L:Length, W :Width note2:disregard if out of AA
		$0.2\text{mm} < \varphi \leq 0.3\text{mm}$	2	
		$0.3\text{mm} < \varphi \leq 0.5\text{mm}$	1	
		$0.5\text{mm} < \varphi$	0	
3	Black dots 、dirty dots 、impurities 、 eye winker (minor defect)	$\varphi \leq 0.15\text{mm}$	disregard	note2:disregard if out of AA 
		$0.15\text{mm} < \varphi \leq 0.25\text{mm}$	2	
		$0.25\text{mm} < \varphi \leq 0.3\text{mm}$	1	
		$0.3\text{mm} < \varphi$	0	
4	Polarizer prick (minor defect)	$\varphi \leq 0.1\text{mm}$	disregard	note1: φ $= (L+W)/2$, L=Length, W=Width note2:the distance between two dots>5mm
		$0.1\text{mm} < \varphi \leq 0.25\text{mm}$	3	
		$\varphi > 0.25\text{mm}$	0	

10.3.1.3 FPC

NO	Defect item	Criteria		Remark
1	Copper screen peel (minor defect)	Copper screen peel 【Reject】		
2	No release tape or peel	No release tape or peel 【Reject】		
3	Dirty dot and impurity of FPC for customer using side (minor defect)	Specification	Allowable	Note1: Cannot have stride ITO impurities
		$\varphi \leq 0.3\text{mm}$	2	
		$\varphi > 0.3$	0	

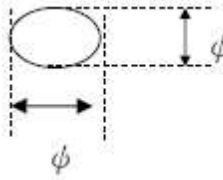
10.3.1.4 Black tape & Mara tape

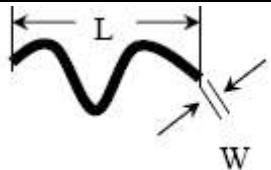
NO	Defect item	Criteria	Remark
1	FPC or H/S black tape (minor defect)	1. shift spec: 1) glue to the polarize 【Reject】 2) IC bare 【Reject】 2. left-and-right spec: 1) exceed of FPC edge or H-S edge 【Reject】 2) IC bare 【Reject】	
2	No black tape (major defect)	No black tape 【Reject】	
3	Tape position mistake (minor defect)	Not by engineering drawing	
4	Mara tape defect (minor defect)	Peel before pulling the protecting film 【Reject】	

10.3.1.5 Silicon and Taffy glue

NO	Defect item	Criteria	Remark
1	Quantity of silicon (major defect)	Uncover the ITO and circuit area 【Reject】	note: compared by engineering
2	Taffy glue (major defect)	1. Uncover the reveal copper area 【Reject】 2. Cover layer 0.3mm(Min)~3.0mm(Max) 【Reject】	note: if customer has special requirement, refer to the technical document
3	Depth of glue covering (major defect)	Depth of glue covering overtop front Polarizer 【Reject】	Except of the special requirement

10.3.1.6 Electrical criteria

NO	Defect item	Criteria	Remark	
1	No display (major defect)	No display 【Reject】		
2	Missing line (major defect)	Missing line 【Reject】		
3	Seg-com light and dark (major defect)	Seg-com light and dark 【Reject】	ND filter 2% test	
4	No display in immobility (major defect)	No display in immobility 【Reject】		
5	Flicker of Pattern (major defect)	Flicker of Pattern 【Reject】		
6	Mura (major defect)	ND filter 2%test		
7	Over current (major defect)	Over current 【Reject】		
8	Voltage out of specification (major defect)	Voltage out of specification 【Reject】		
9	Pattern blur, error code (major defect)	Pattern blur, error code 【Reject】		
10	Dark light, Flicker (major defect)	Dark light, Flicker 【Reject】		
11	Black/white dots 、 Dirty dots 、 eye winker (major defect)	Specification	Allowable	Note1 :disregard if out of 
		$\varphi \leq 0.15\text{mm}$	disregard	
		$0.15\text{mm} < \varphi \leq 0.25\text{mm}$	2	
		$0.25\text{mm} < \varphi \leq 0.3\text{mm}$	1	
		$0.3\text{mm} < \varphi$	0	
12	Fiber 、 glass crutch 、 Polarizer scratch/folded (major defect)	$W \leq 0.03\text{mm}$	disregard	Note1:L: Length, W: Width Note2: disregard if out of AA
		$0.03\text{mm} < W \leq 0.05\text{mm}$	2	
		$L \leq 4.0\text{mm}$		
		$0.05\text{mm} < W \leq 0.1\text{mm}$	1	

		$L \leq 4.0\text{mm}$		
		$W > 0.1\text{mm}; L > 4.0\text{mm}$	0	

11 Packing Method

TBD