PRODUCT SPECIFICATION
FOR LCD MODULE

Revision:

Model No:

Module Type: COG+FPC+B/L

APPROVED SIGNATURE

□ Approved Product Specification only
■ Approved Product Specification and Samples

Prepared By	Checked By	Approved By

Contents

1. General Description

        is a transmissive type a-Si TFT-LCD (amorphous silicon thin film transistor liquid crystal display) module, which is composed of a TFT-LCD panel, a driver circuit and a backlight unit. The panel size is 2.4 inch and the resolution is 240*320, the panel can display up to 262K colors. The LCM can be easily accessed by micro-controller via MCU interface.

2. Physical   Features

Display Mode	TFT-LCD Module
	Active matrix TFT, Transmissive type
Display Format	Graphic 240×RGB×320 Dot-matrix
Input Data	The Data input by MCU interface
Viewing Direction	12 O'CLOCK
Drive	ST7789V

3. Mechanical Specification

Item	Contents	Unit
Module size (W×H×T)	42.70× 60.20× 2.40	mm
Number of dots	240(RGB) × 320	---
Active area (W×H)	36.72×48.96	mm

4. Outline Dimension
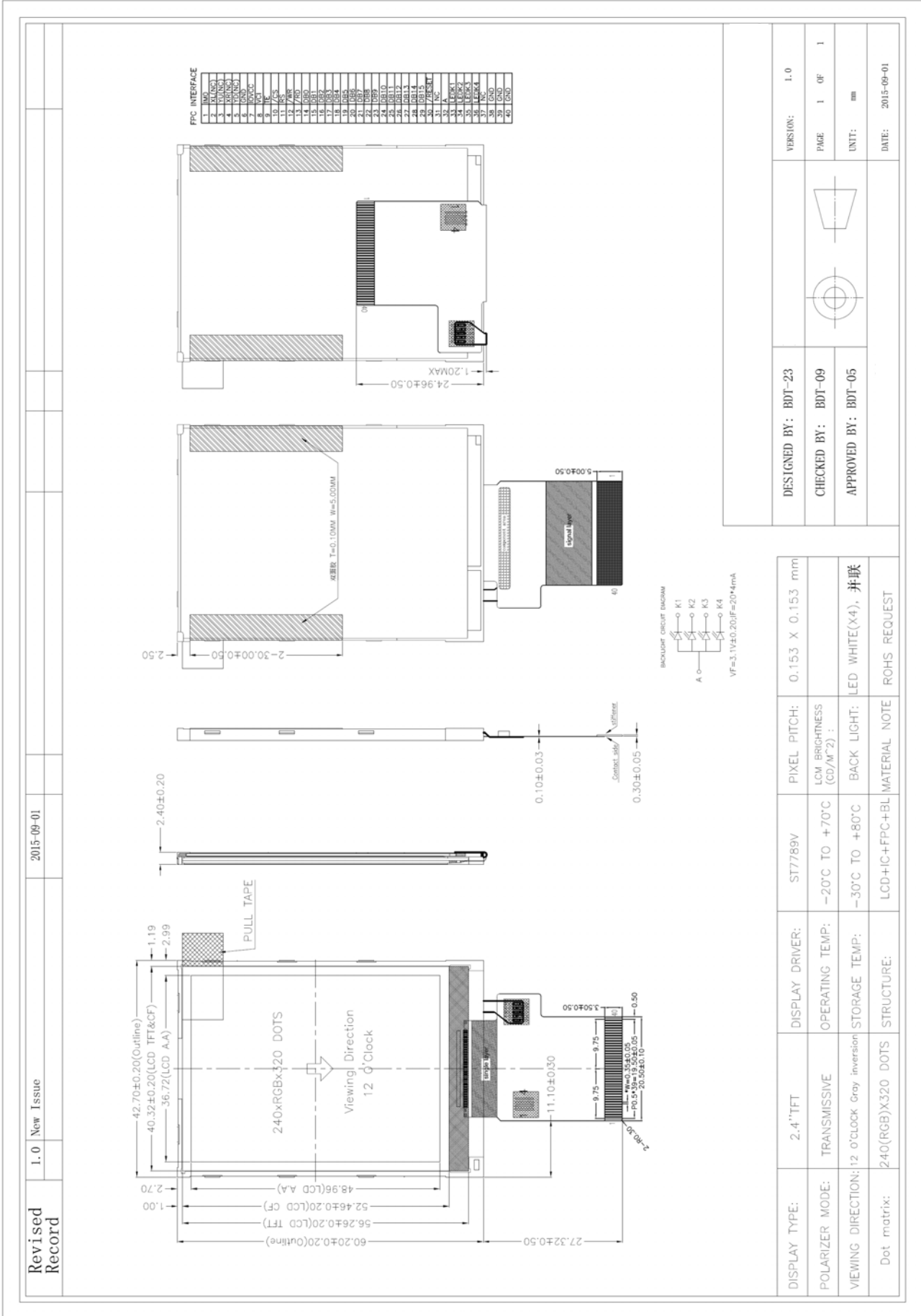
5. Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Remark
Power Voltage	VCC	-0.3	4.6	V	
Input Voltage	VIN	-0.3	VCC+0.3	V	
Operating temperature	TOPR	-20	70	℃	
Storage temperature	TSTR	-30	80	℃	
Humidity	---	---	90	%RH	---

If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.
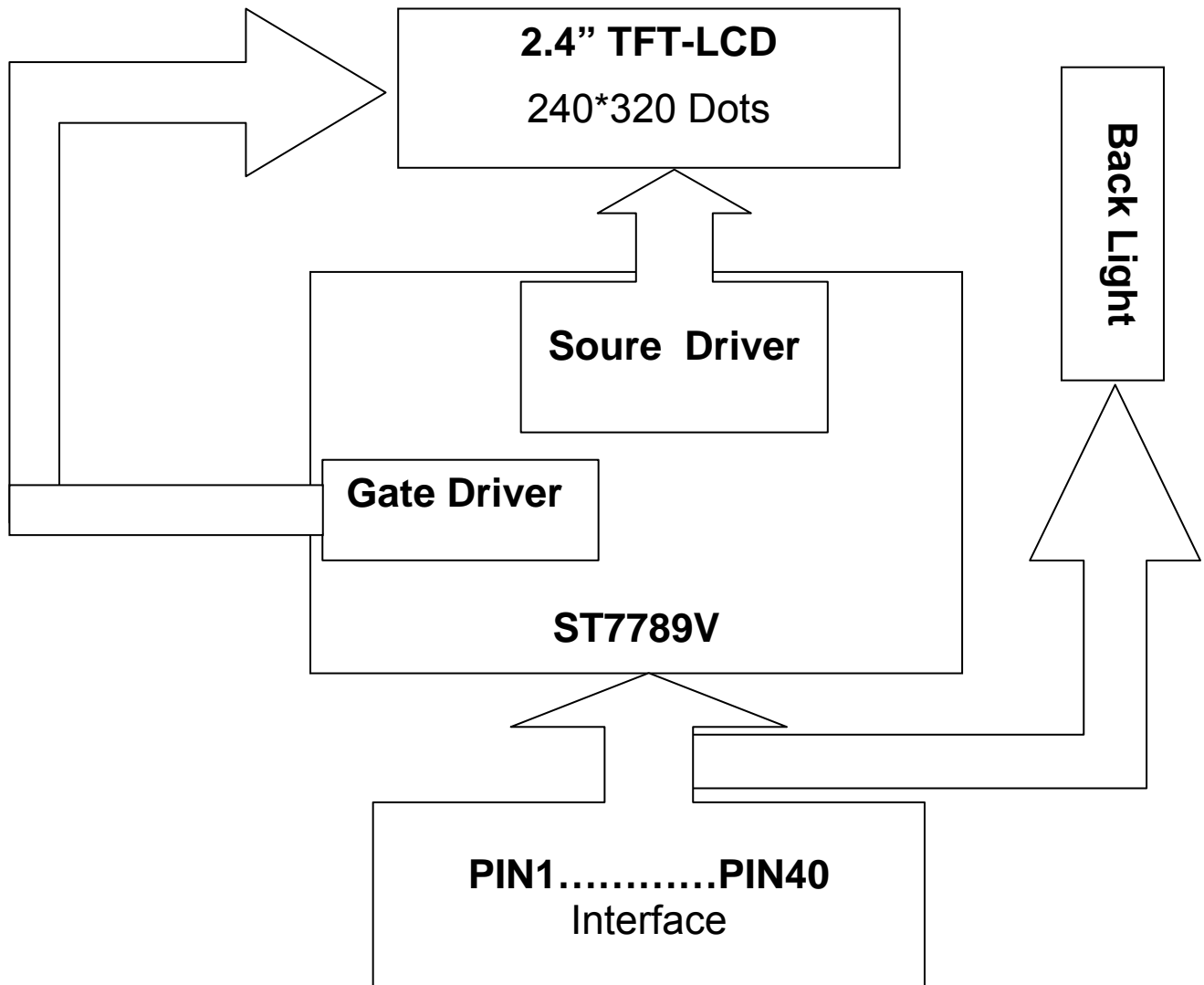
6. Electrical Characteristics

Item		Symbol	Rating			Unit	Remark
			Min	Typ	Max		
Power Voltage	Logic	VCC	2.5	2.8	3.3	V	Note1
Input Voltage	L level	VIL	VSSD	---	0.3IOVCC	V	IOVCC= 1.65-3.3V
	H level	VIH	0.7IOVCC	---	IOVCC	V	
LCD Drive Power current		ILCD	---	---	---	mA	---

Remark:
   Note1:Vcom must be adjusted to optimize display quality: Cross-talk, Contrast Ratio and etc.

7. Module Function Description

7-1. Block Diagram Of LCM

```
                    ┌─────────────────────┐         ┌──────────┐
          ┌────────▶│    2.4" TFT-LCD      │         │          │
          │         │    240*320 Dots      │         │  Back    │
          │         └─────────────────────┘         │  Light   │
          │              ▲                            │          │
          │         ┌───────────────────────┐        │          │
          │         │   ┌───────────────┐   │        └──────────┘
          │         │   │ Soure  Driver │   │              ▲
          │         │   └───────────────┘   │              │
          │ ┌───────────┐                   │              │
          └─│Gate Driver│                   │              │
            └───────────┘                   │              │
            │                               │              │
            │         ST7789V               │              │
            └──────────────▲────────────────┘              │
                           │                               │
                    ┌──────────────────────┐               │
                    │  PIN1…………PIN40        │               │
                    │     Interface         │───────────────┘
                    └──────────────────────┘
```

7-2. Pin Description

PIN NO.	Symbol	I/O	Description
1	IM0	I	the MCU interface mode Select PIN IM0=1 , DB[15:8] ; IM0=0 , DB[15:0]
2	XL	I	NC
3	YU	I	NC
4	XR	I	NC
5	YD	I	NC
6	GND	P	Ground
7	IOVCC	P	Digital IO Pad power supply(1.8V/2.8V)
8	VCI	P	Analog power supply
9	TE	O	Tearing effect signal is used to synchronize MCU to frame memory writing.
10	CS	I	Chip select pin
11	RS	I	Command and Data select pin
12	/WR	I	Write enable pin
13	/RD	I	Read enable pin
14-29	DB0-DB15	I/O	Data Bus
30	/RESET	I	Reset pin.
31	NC		NC
32	LEDA	BL POWER SUPPLY	Anode pin of backlight
33-36	LEDK1-4	BL POWER SUPPLY	Cathode pin of backlight
37	NC		NC
38-40	GND	P	Ground

7-3. Timing Characteristics
7.3.1
## Display Parallel 18/16/9/8-bit Interface Timing Characteristics(8080-II system)
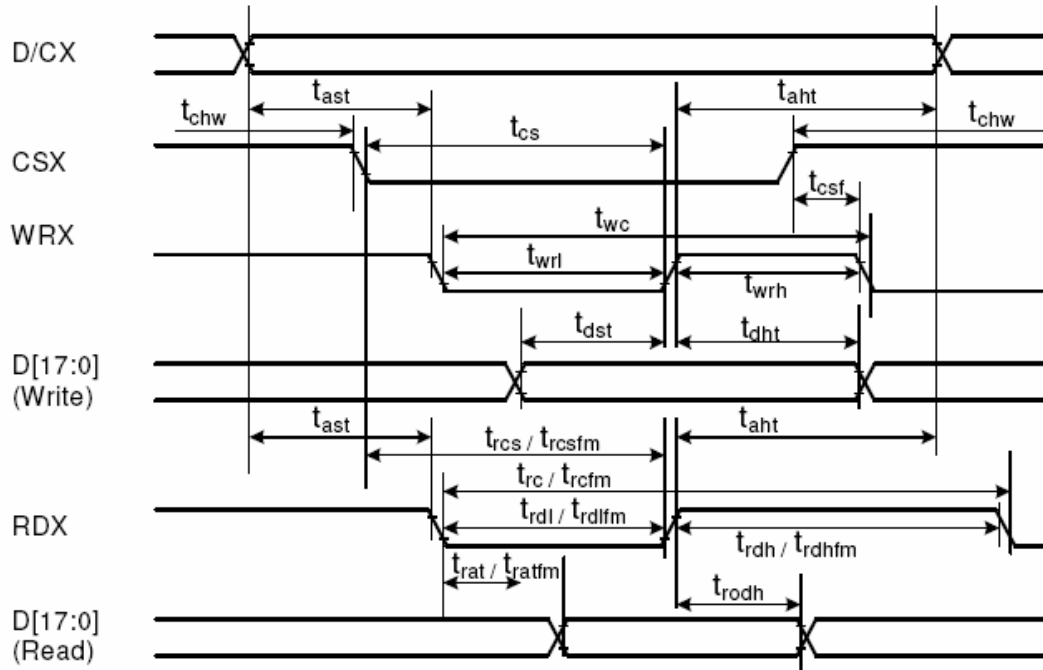
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: Ta = -30 to 70 ℃, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.
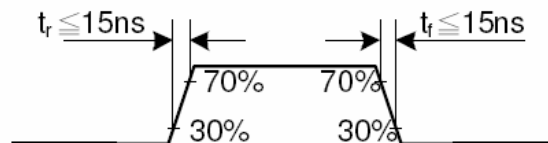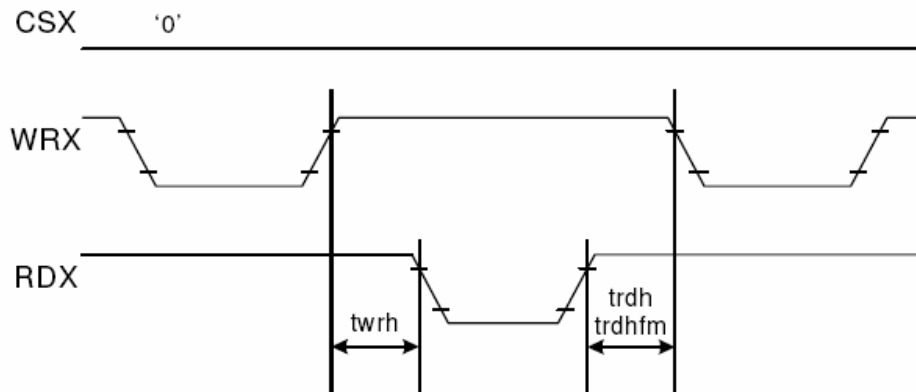
CSX timings :
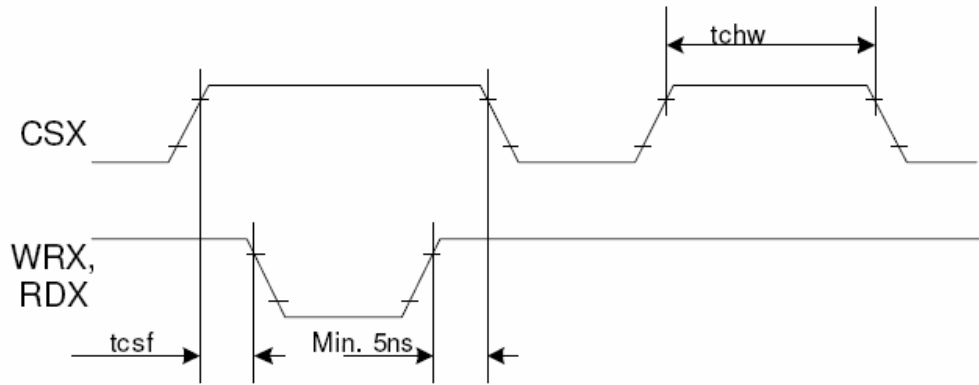
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:

Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

8. Backlight Characteristics

Item	Symbol	Min	Typ	Max	Unit	Condition	Remark
Forward voltage	V$_{BL}$	2.9	3.1	3.3	V		-
Current	I$_{BL}$	-	80		mA	IF=80mA（恒定电流测试）	-
ICE	X	0.22	-	0.32	-		
	Y	0.22	-	0.32	-		-
Brightness of LCM	-	200	245	290	cd/m²		★1
Uniformity	-	80	-	-	%		★2

★1 Test condition is：

    (a) Center point on active area

    (b) Best Contrast

★2 Uniform measure condition：

    (1)Measure 9 point. Measure location is show below：

    (2)Uniform = (Min. brightness / Max. brightness)×100%

    (3)Best Contrast.
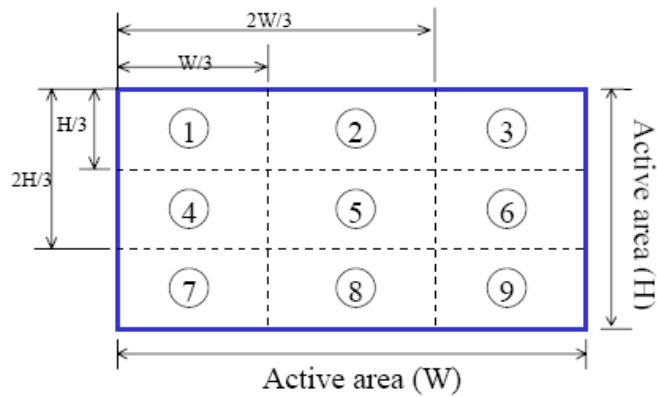
9. Electro-Optical Characteristics

Item		Symbol	Conditions	Specifications			Unit	Note
				Min.	Typ.	Max.		
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$	4.5	5.0	-	%	All left side data are based on CMI's following condition – 1.LC : TN 2.Light Source :CMI LED BLU 3.Film : 日東 NPF TEG 1465DU 4.Machine : DMS 803
Contrast Ratio		CR		-	250	-		
Response Time (by Quick)		$T_{on} + T_{off}$		-	30	-	ms	
Viewing Angle	Hor.	θ_{X+}	Center CR>10	-	45	-	deg.	
		θ_{X-}		-	45	-		
	Ver.	θ_{Y+}		-	45	-		
		θ_{Y-}		-	20	-		
CF only Color Chromaticity (CIE 1931)	Red	X_R	Viewing normal angle $\theta_X = \theta_Y = 0°$	0.592	0.612	0.632		1.Under C light Simulation 2.NTSC 56%
		Y_R		0.309	0.329	0.349		
	Green	X_G		0.279	0.299	0.319		
		Y_G		0.547	0.567	0.587		
	Blue	X_B		0.124	0.144	0.164		
		Y_B		0.090	0.110	0.130		
	White	X_W		0.288	0.308	0.328		
		Y_W		0.305	0.325	0.345		

*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.
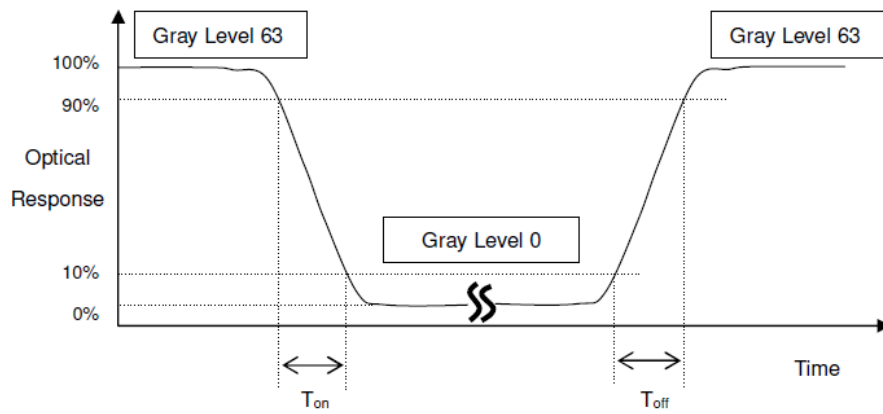
Contrast Ratio (CR) = L63 / L0

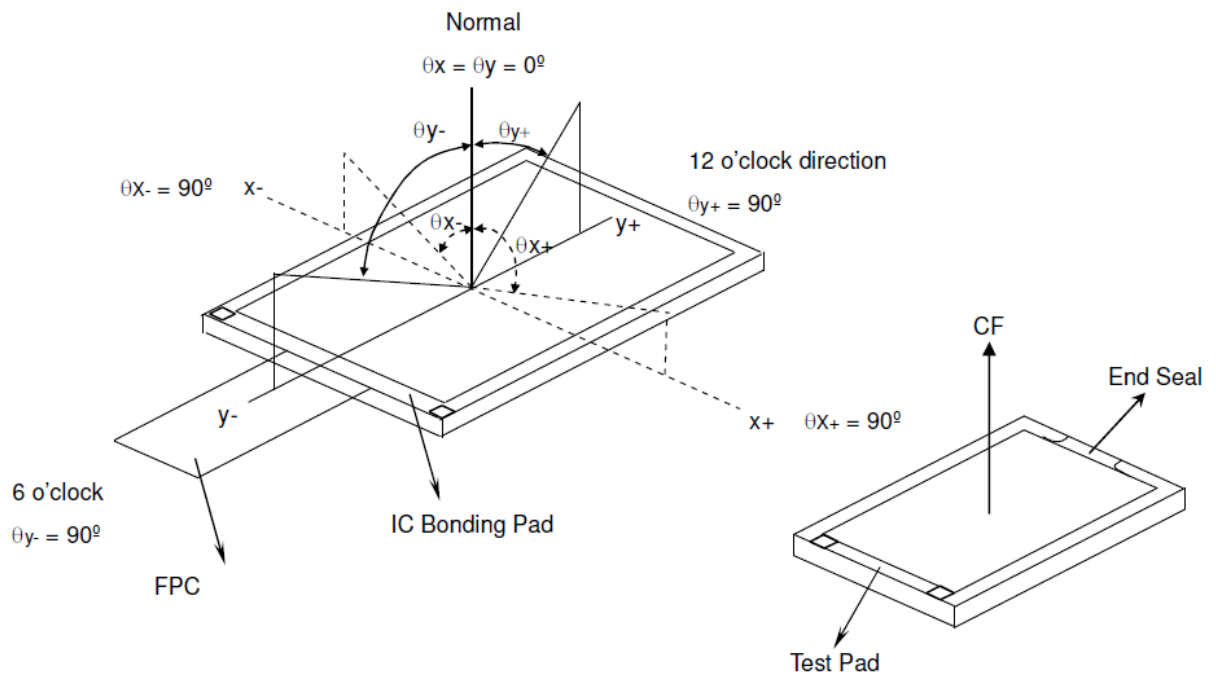L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

*Note (2) Definition of Response Time (T_{on}, T_{off}):
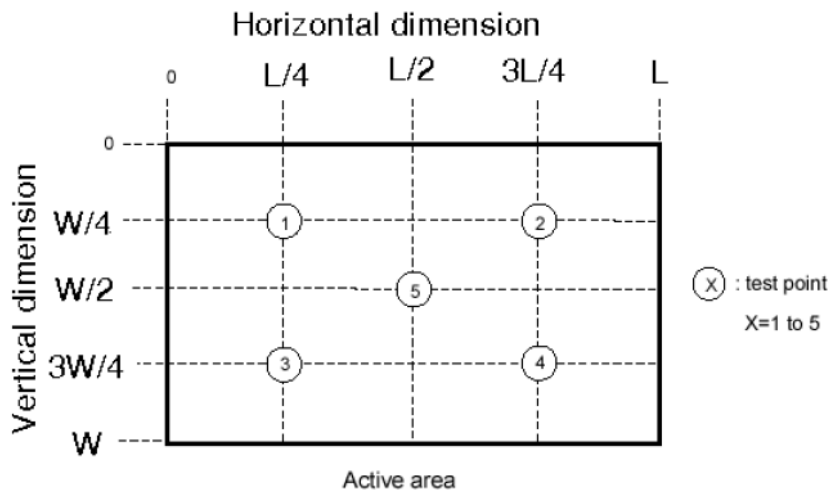

*Note (3) Definition of Viewing Angle

*Note (4) Measurement Set-Up:

    The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.
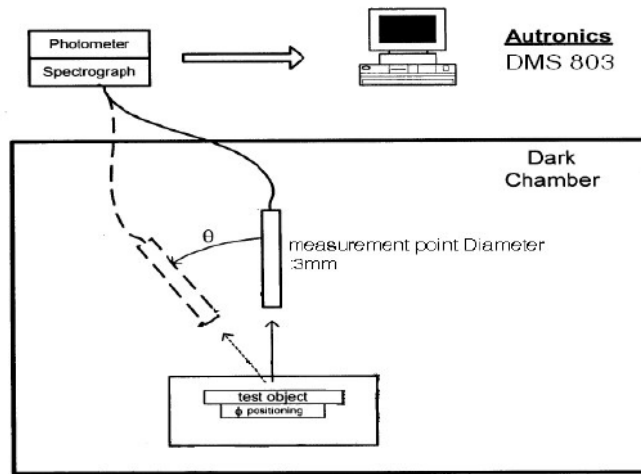
*Note (5)

10. Reliability

10.1. MTBF

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal. (25°C in the room without sunlight)

10.2. Test condition

ITEM	CONDITIONS	CRITERION
OPERATING TEMPERATURE	HIGH TEMPERTURE +70℃ 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
	LOW TEMPERTURE -20℃ 48HRS	
STORAGE TEMPERATURE	HIGH TEMPERTURE +80℃ 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
	LOW TEMPERTURE -30℃ 48HRS	
HUMIDITY	60℃ 90%RH 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION

Note：The need to restore at room temperature for 2 hours after the test。

11. Inspection Standards

1. AQL(Acceptable Quality Level)

   AQL of major and minor defect

   According to GB/T 2828-2003 ; , normal inspection, Class Ⅱ

MAJOR DEFECT	MINORDEFECT
0.65	1.5

2. Basic conditions for inspection

   The LCM face to us, in normal environment, 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!
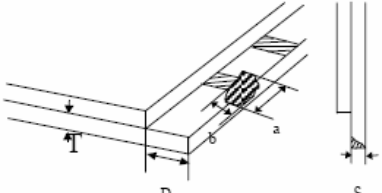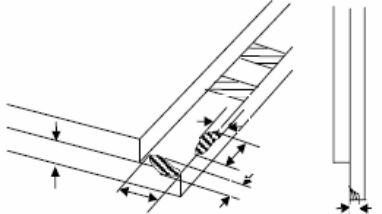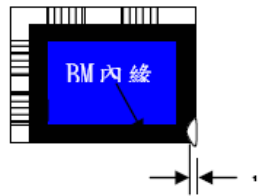
   (As shown below)
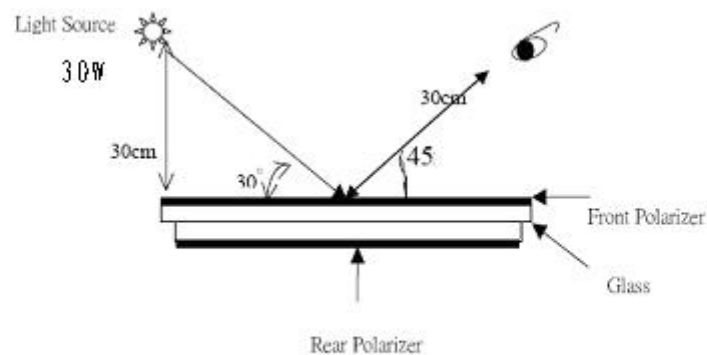
3. Inspection item and criteria

3.1 Visual inspection criterion in immobility

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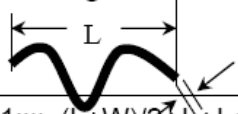
No	Defect item	Criteria	Remark
1	Dimension Unconformity (Major defect)	By Engineering Drawing	

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≦1/3Pin width(non bonding area) 【Accept】 2) bonding area≦0.5mm 【Accept】	a:Length,　b:Width
4	Pin-side，conductive area damaged (minor defect)	(a　c：disregards) b≦ 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 (Inclueling contraposition mark,except scribing mark) 【Accept】 2) c<T b≦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

No	Defect item	Criteria	Remark
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

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
		0.05mm<W≦0.1mm; L≦3.0mm	1	
		W>0.1mm ; L>3.0mm	0	
2	Polarizer bubble、concave and convex (minor defect)	ψ≦0.2mm	disregard	note 1:ψ=(L+W)/2；L：Length，W：Width note2: disregard if out of AA
		0.2mm<ψ ≦ 0.3mm	2	
		0.3mm<ψ ≦ 0.5mm	1	
		0.5mm<ψ	0	
3	Black dots、dirty dots、impurities、eyewinker (Major defect)	ψ≦0.15mm	disregard	note2: disregard if out of AA
		0.15mm<ψ ≦ 0.25mm	2	
		0.25mm<ψ ≦ 0.3mm	1	
		0.3mm<ψ	0	
4	Polarizer prick (Major defect)	ψ≦0.1mm	disregard	note1:ψ=(L+W)/2 ；L= Length，W=Width note2: the distance between two dots ＞5mm
		0.1mm<ψ≦0.25mm	3	
		ψ＞0.25mm	0	

3.1.3 .FPC
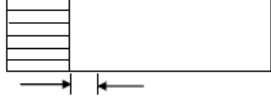
No	Defect item	Criteria		Remark
1	Copper screen peel (Major defect)	Copper screen peel 【Reject】		
2	No release tape or peel (Major defect)	No release tape or peel 【Reject】		
3	Dirty dot and impurity of FPC for customer using side (minor defect)	Specification	Allowable	note1: Cannot have stride ITO impurities
		ψ≦0.25mm	2	
		ψ>0.25	0	

3.1.4 Black tape & Mara tape

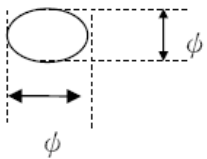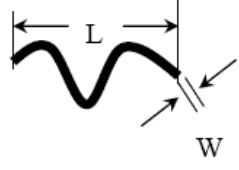|	Defect item	Criteria	Remark
1	FPC or H/S black tape shift (minor defect)	1.shift spec: 1)glue to the polarize 【Reject】 2) IC bare 【Reject】 2. left-and-right spec: 1) exceed of FPC edge or H-S edge 【Reject】 2)IC bare 【Reject】	
2	No black tape (Major defect)	No black tape 【Reject】	
3	Tape position mistake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

3.1.5 Silicon and Tuffy glue

No	Defect item	Criteria	Remark
1	Quantity of silicon (minor defect)	Uncover the ITO and circuit area. 【Reject】	note: compared by engineering drawing.

No	Defect item	Criteria	Remark
2	Tuffy glue (minor defect)	1. Uncover the reveal copper area 【Reject】 2. Cover layer 0.3mm(Min) ~ 3.0mm(Max) 【accept】	note:if customer has special requirement , refer to the technical document.
3	Depth of glue covering (minor defect)	Depth of glue covering overtop front Polarizer 【Reject】	Except of the special requirement。

3.2 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】	

No	Defect item	Criteria		Allowable	Remark
11	Black/White dots 、 Dirty dots 、eyewinker (Major defect)	Specification		Allowable	Note1: disregard if out of AA
		ψ≦0.15mm		disregard	
		0.15mm<ψ ≦ 0.25mm		2	
		0.25mm<ψ ≦ 0.3mm		1	
		0.3mm<ψ		0	
12	Fiber 、 glass cratch 、 polarizer scratch/folded (minor defect)	W≦0.03mm		disregard	note1: L：Length、W：Width note2: disregard if out of AA
		0.03mm<W≦0.05mm ; L≦3.0mm		2	
		0.05mm<W≦0.1mm; L≦3.0mm		1	
		W>0.1mm ; L>3.0mm		0	

12. Precautions For Using LCD Modules

Please pay attentions to the followings as using the LCD module.

12.1 Handling

(a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.

(b) Because the ITO film very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.

(c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.

(d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.

(e) Wipe off water droplets or oil immediately.

(f) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.

(g) Do not touch the output pins directly with bare hands.

(h) Do not disassemble the LCD module.

12.2 Storage

(a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.

(b) Do not expose the LCD modules to sunlight directly.

(c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.

(d) Avoid condensation of water. It may cause improper operation.

(e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

12.3 Operation

(a) When mounting or dismounting the LCD modules, turn the power off.

(b) Protect the LCD modules from electric shock.

(c) The Driver IC control algorithms stated above should always obeyed to avoid damaging the LSI and electronic circuit.

(d) Be careful to avoid mixing up the polarity of power supply for backlight.

(e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.

(f) When a static image is displayed for a long time, remnant image is likely to occur.

(g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.

12.4 Others

(a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.

(b) It is recommended to peel off the protection film on the ITO film slowly so that the electrostatic charge can be minimized.

(c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.

13. Records Of Version

Version	Revise Date	Page	Content
V0	2015-10-06	All	New Version