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System solutions

OEM Solutions

Custom Display

Mechanical design



MODEL NO : ET015QV01-T

MODEL VERSION: 01

SPEC VERSION : 1.0

ISSUED DATE: 2021-01-27

☐ Preliminary Specification

☒ Final Product Specification

Customer : _____

Approved by	Notes

Youri Confirmation

Prepared by	Reviewed by	Approved by
John	Johnny	Wang

1. Introduction

1.1 Scope of application

LCD specification: Dots 240xRGBx240.

As to basic specification of the driver IC, refer to the IC (ST7789V2) specification and data book.

All material & processing of the LCD module should be Lead Free.

1.2 TFT features:

Structure: TFT PANNEL+IC +FPC+BL;

IPS Type LCD

240dot-segment and 240 dot-common outputs;

65K/262 Color can be selected by software;

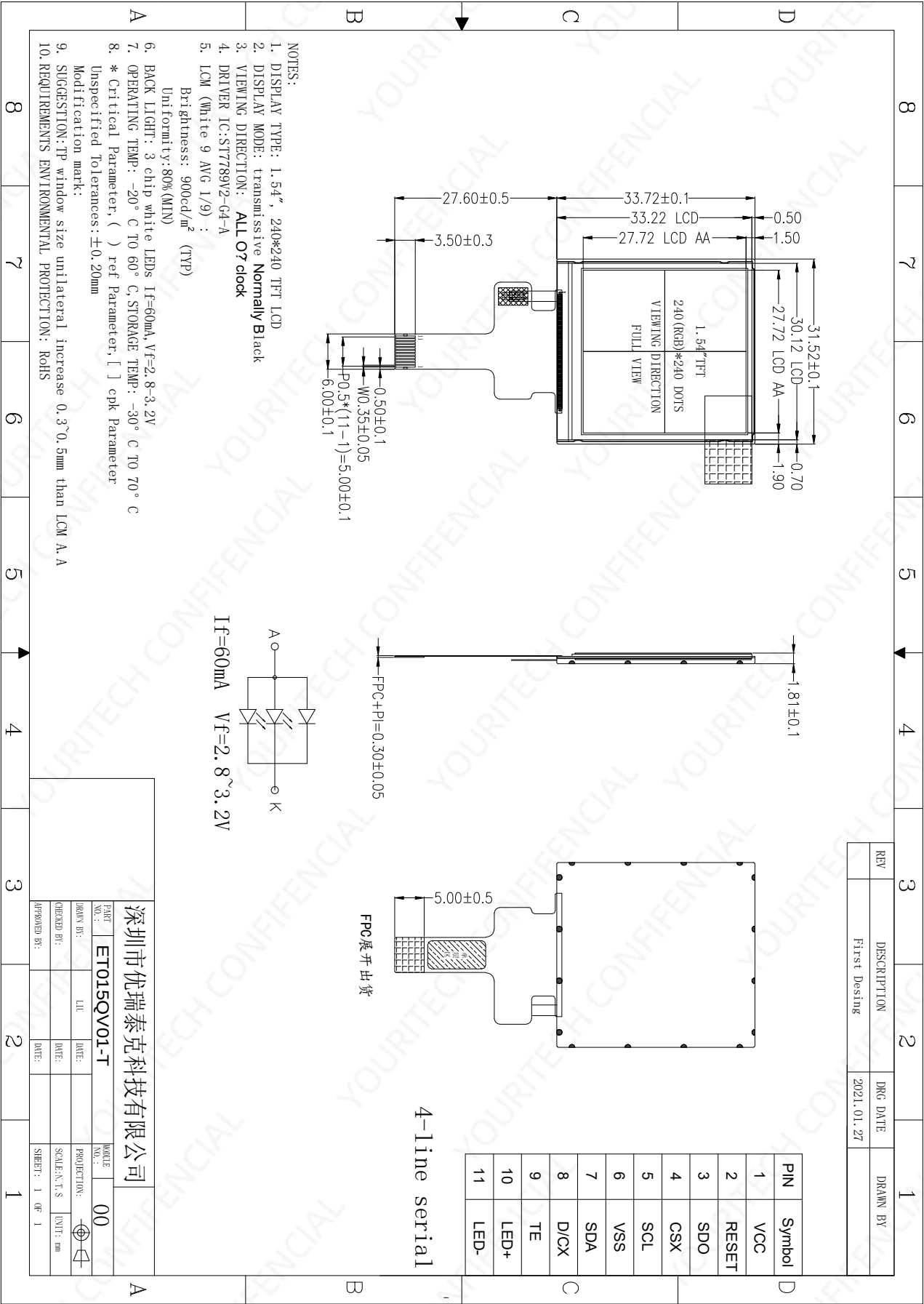
White LED back light;

4line SPI interface

1.3 Applications:

2. LCM General specification

ITEM	Standard value	Unit
LCD Type	Normally Black	--
Drive element	TFT active matrix	--
Number of pixels	240*3RGB(H)X240(V)	Dots
Pixel arrangement	RGB stripe	--
Pixel Pitch (W*H)	0.1155(W) × 0.1155(H)	mm
Active area	27.72(W) × 27.72 (H)	mm
Viewing direction	ALL O'CLOCK	-
TFT Driver IC	ST7789V2	
TFT interface	4line SPI interface	-
Approx. Weight	TBD	g
Module Size(W*H*T)	31.52(W) × 33.72(H) × 1.81(T)	mm
Touch structure	--	
Touch Driver IC	--	-
Touch Interface	--	



3.Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit
LCM Operating Temperature	T _{OPR}	-20	+60	°C
LCM Storage Temperature	T _{STG}	-30	+70	°C
Humidity	RH	-	90	%

4.Electrical Characteristics

4.1 TFT DC Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Frame Rate	T _v	--	60	--	Hz
Supply Voltage for(DC/DC)	VDD	2.5	2.8	3.3	V
Current Consumption	I _{DD}	--	10	--	mA
	I _{DD-SLEEP}	--	150	--	uA

4.2 Back-Light Unit Characeristics

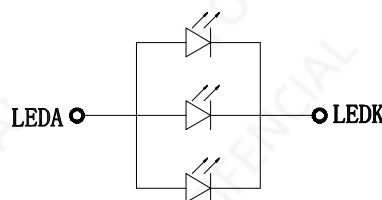
The back-light system is an edge-lighting type with 3 white LEDs. The characteristics of the back-light are shown in the following tables.

Characteristics	Symbol	Min.	Type	Max.	Unit	Notes
Forward Voltage	V _F	2.8	--	3.2	V	-
Forward current	I _F	--	60	--	mA	-
Luminance(With LCD)	L _v	--	900	--	cd/m ²	-
LED life time	N/A	----	30,000	--	Hr	Note 1

Note:

- (1) The “LED life time” is defined as the module brightness decrease to 50% of original brightness at I_L=20mA/LED. The LED life time could be decreased if operating I_L is larger than 25mA/LED.

Backlight circuit diagram shown in below:



5. Module Function Description

Pin No.	Symbol	Description
1	VCI2.8V	POWER SUPPLY (2.5~3.3V)
2	RESET	Hardware reset
3	SDO	Serial data output pin.
4	CSX	Chip selection signal.
5	SCL	Serial clock signal.
6	VSS	Ground.
7	SDA	Serial data input/output pin.
8	D/CX	Register selection signal.
9	TE	Frame head pulse for tearing effect.
10	LEDA	BACKLIGHT +
11	LEDK	BACKLIGHT-

6. Timing Characteristics

Power ON/OFF Sequence

Power on/off sequence suggestion:

VDD powered on before the VDDI.

VDDI powered off before the VDD.

During power off, if LCD is in the Sleep Out mode, VDD and VDDI must be powered down minimum 120msec after RESX has been released.

During power off, if LCD is in the Sleep In mode, VDDI or VDD can be powered down minimum 0msec after RESX has been released.

CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX.

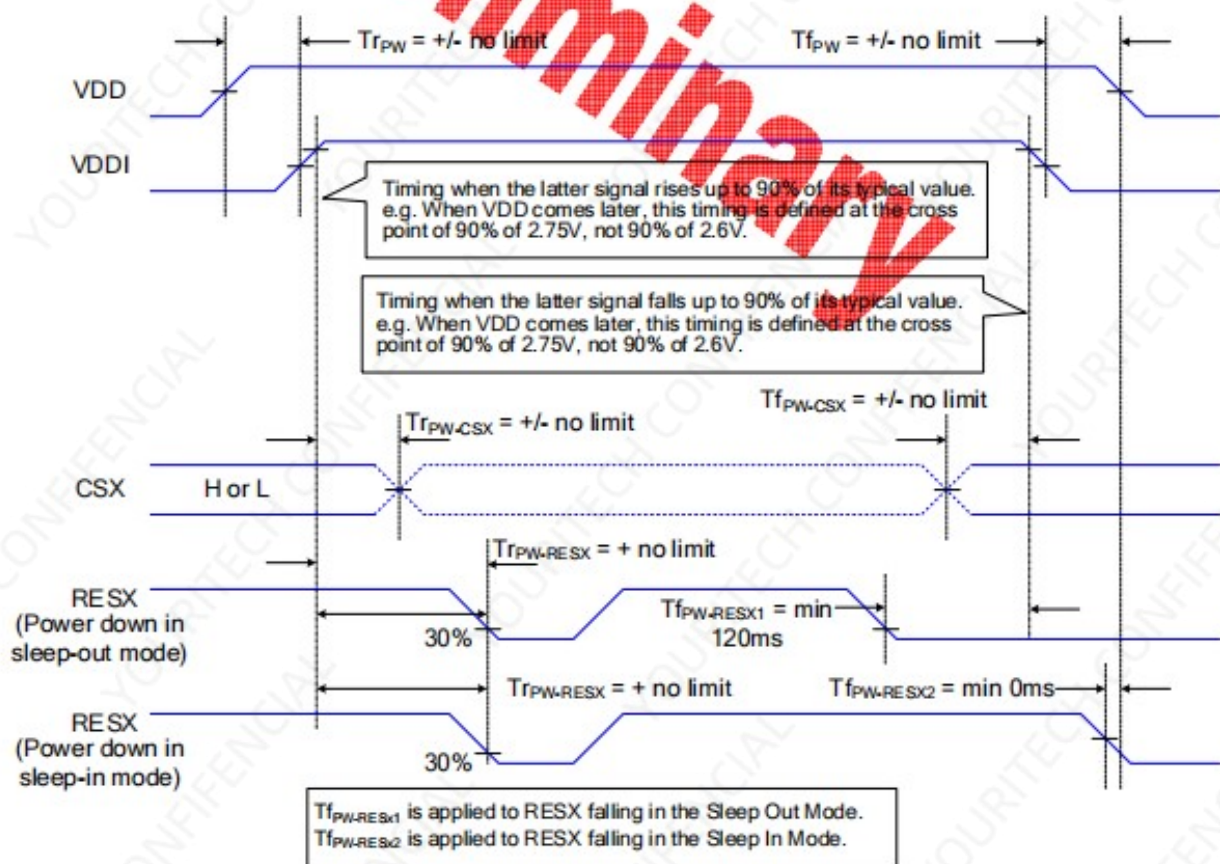
Note 1: There will be no damage to the display module if the power sequences are not met.

Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.

Note 4: If RESX line is not held stable by host during Power On Sequence as defined in the sequence below, then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

The power on/off sequence is illustrated below



Serial Interface Characteristics (4-line serial):

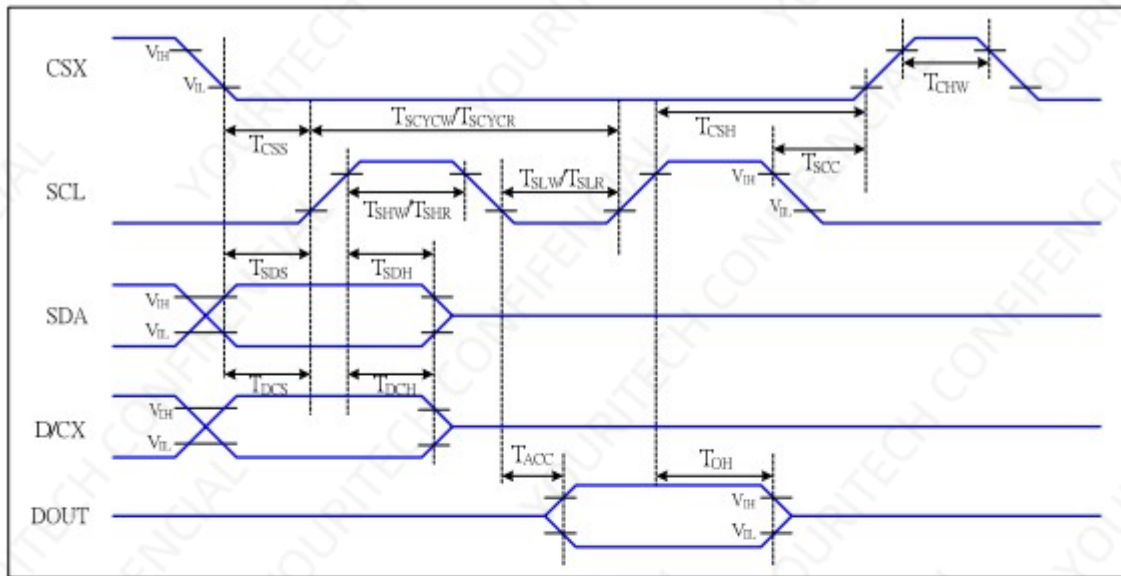


Figure 5 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

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

Table 6 4-line serial Interface Characteristics

Reset Timing:

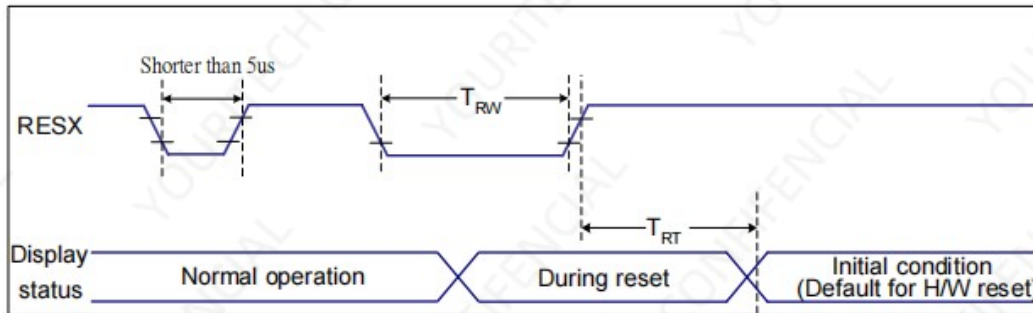


Figure 7 Reset Timing

$VDDI=1.65$ to $3.3V$, $VDD=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70^\circ C$

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 8 Reset Timing

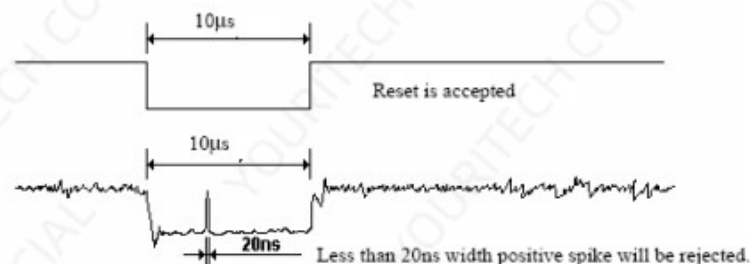
Notes:

- 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.
- 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

- 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.

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



- When Reset applied during Sleep In Mode.
- When Reset applied during Sleep Out Mode.
- It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

7.Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (with Polarizer)		T(%)	—		5	—	%	
Transmittance (without Polarizer)		T(%)	—		16.5	—	%	
Contrast Ratio		CR	Θ=0 Normal viewing angle		800	—	—	(1)(2)
Response Time		T _R + T _F		—	30	40	msec	(1)(3)
Color Gamut		S(%)			50	—	%	
Color Chromaticity (CIE1931)	White	W _x		0.283	0.303	0.323	(1)(4) CF glass	
		W _y		0.305	0.325	0.345		
	Red	R _x		0.600	0.620	0.640		
		R _y		0.312	0.332	0.352		
	Green	G _x		0.264	0.284	0.304		
		G _y		0.514	0.534	0.554		
	Blue	B _x		0.126	0.146	0.166		
		B _y		0.109	0.129	0.149		
Viewing Angle	Hor.	Θ _L	CR>10	—	80	—	Viewing Angle base on using Normal Polarizer , Reference Only	
		Θ _R		—	80	—		
	Ver.	Θ _U		—	80	—		
		Θ _D		—	80	—		
Optima View Direction		ALL						(5)

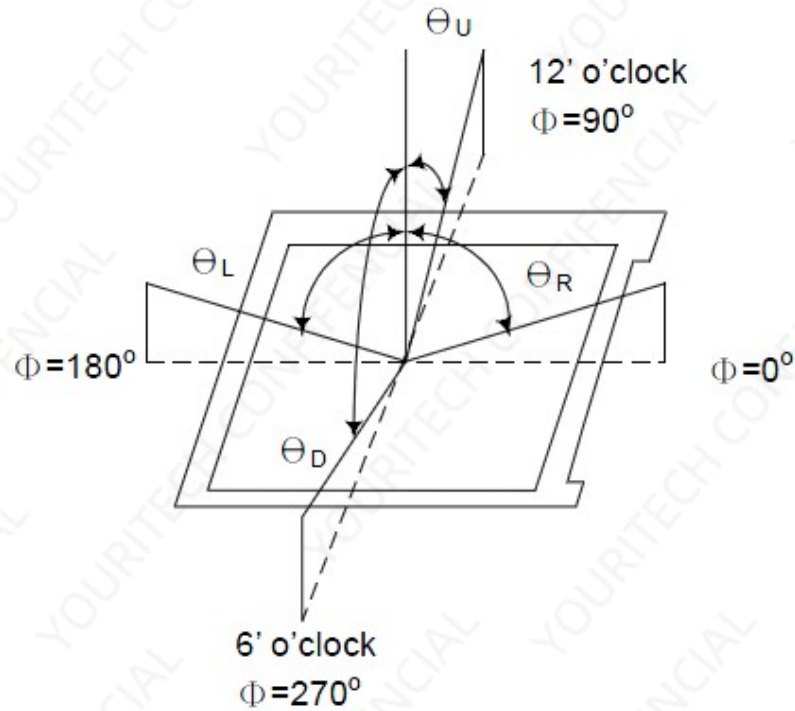
Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : $25 \pm 2^\circ\text{C}$
- 15min. warm-up time.

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

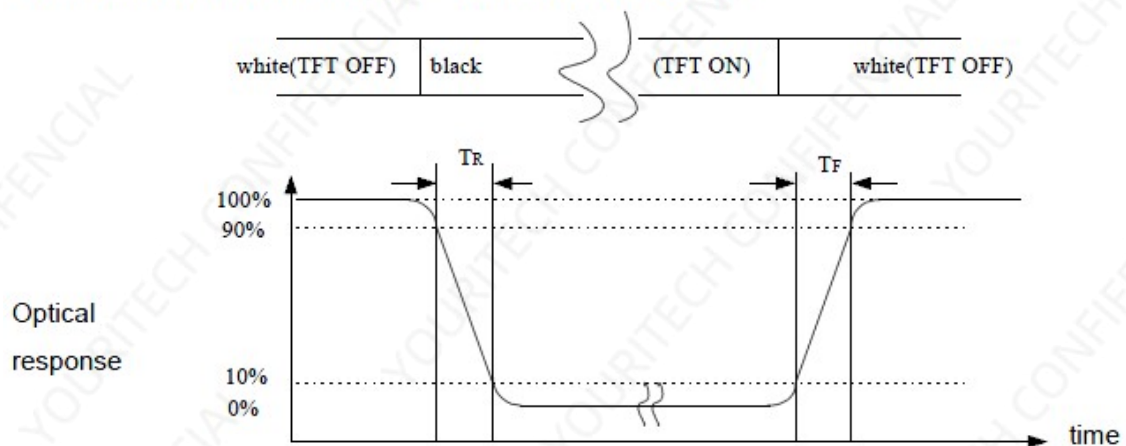
Note (1) Definition of Viewing Angle:



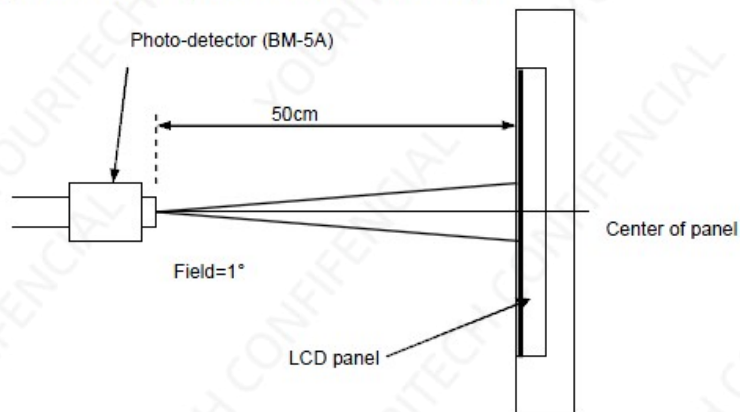
Note (2) Definition of Contrast Ratio (CR):
 measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

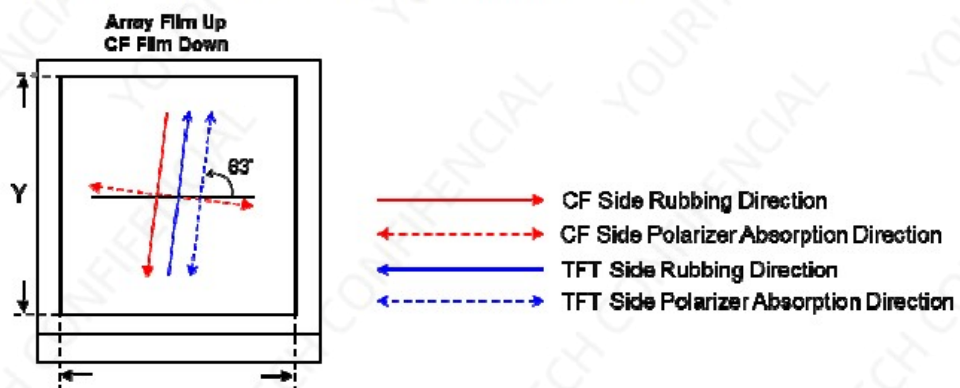
Note (3) Definition of Response Time: Sum of T_R and T_F



Note (4) Definition of optical measurement setup



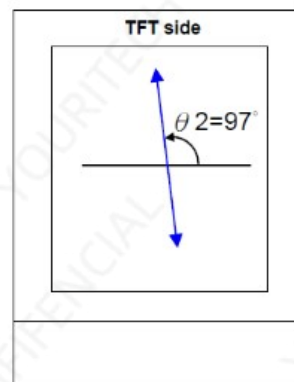
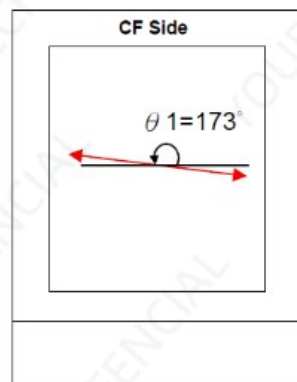
Note (5) Rubbing Direction & Polarizer Absorption Direction



Item	Specifications	Unit	Note
Rubbing Direction	83°(TFT) / 263°(CF)	degree	1-domain IPS-pro
Absorption axis of Polarizer	83°(TFT) / 173°(CF)	degree	Array Film Up CF Film Down

CF side polarizing absorption angle $\theta 1=173^\circ$ (Protective film on top, glue layer face down)

TFT side polarizing absorption angle $\theta 2=97^\circ$ (Protective film on top, glue layer face down)



8. Reliability Test Item

No.	Test Item	Test Condition	Notes
1	High Temp. Storage	+70°C / 96H	1. Functional test is OK. Missing Segment, short, unclear segment non-display, display abnormally and liquid crystal leakage 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	+60°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	

9. Packing Method----TBD

- END -