

STP0144C-128128 Series TFT LCD PANEL USER MANUAL

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Reference Controller Datasheet

TFT LCD Panel Selection Guide

ST7735S

REVISION RECORD

<u>REV NO</u>	<u>REV DATE</u>	<u>CONTENTS</u>	<u>REMARKS</u>
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1.0 General Specifications

STP0144C-128128 is a color active matrix LCD module incorporating amorphous silicon **TFT** (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC and a back light unit. The module display area contains **128X128** pixels and can display up to **262K** colors. This product accords with RoHS environmental criterion.

Item	Contents	Unit
LCD Type	TFT TRANSMISSIVE	/
Viewing direction	12:00	O' Clock
Module outline (W x HxD)	27.90 x32.64 x1.90	mm
Active area (WxH)	25.50 x26.50	mm
Number of Dots	128(RGB) x128	/
Driver IC	ST7735S	/
Colors	262K	/
Backlight Type	2 LED Parrallel	/
Interface Type	4 SPI Serial interface	/
Input voltage	2.8~3.3V	V

2.0 ABSOLUTE MAXIMUM RATINGS

<i>Parameter</i>	<i>Symbol</i>	<i>Min</i>	<i>Max</i>	<i>Unit</i>
Supply voltage for logic	Vcc1,Vcc2	-0.3	4.6	V
Input voltage	Vin	-0.3	VCC+ 0.3	V
Operating temperatur	Top	-20	70	°C
Storage temperature	Tst	-30	80	°C
Humidity	RH	--	90%(Max60C)	RH

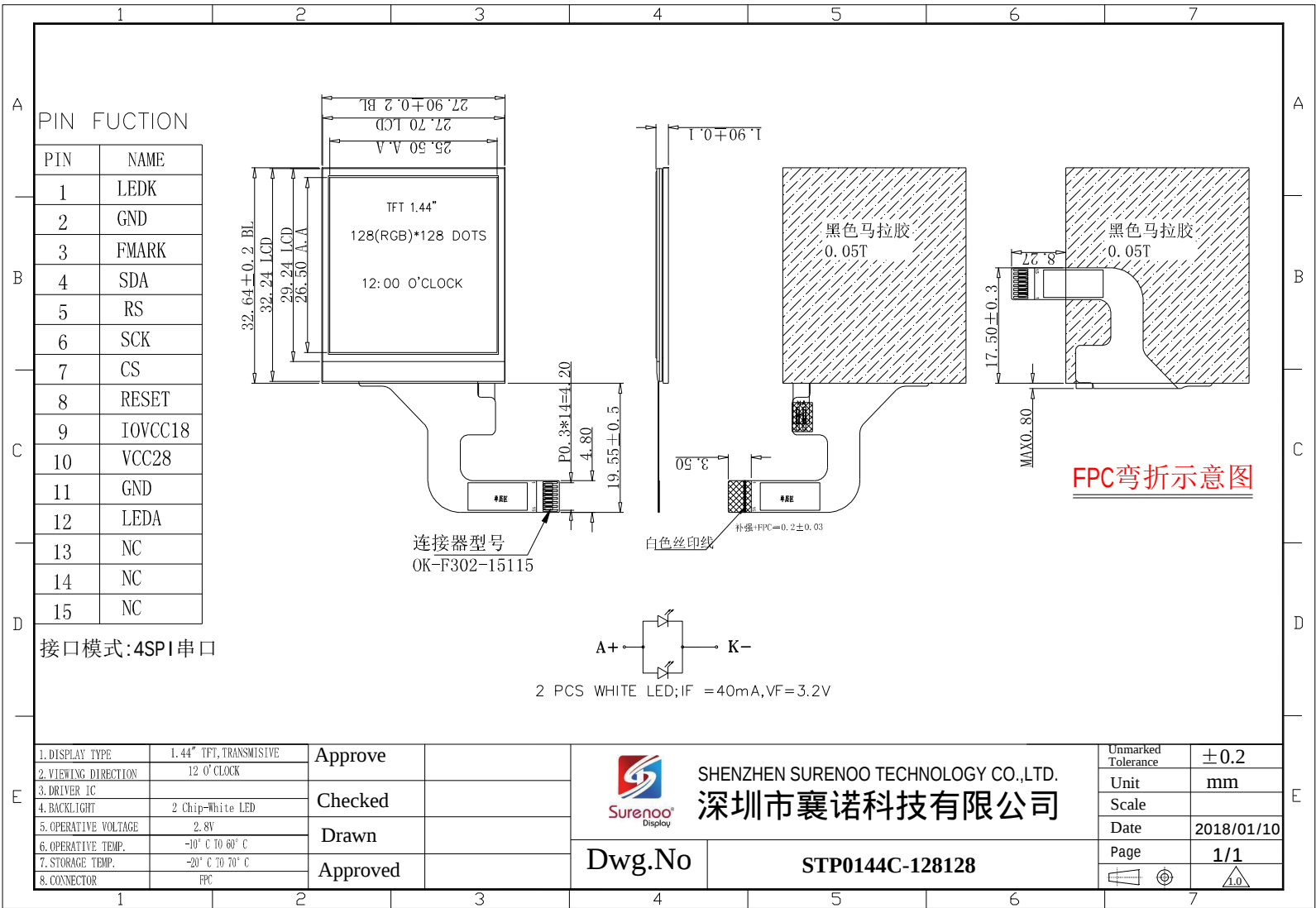
3.0 ELECTRICAL CHARACTERISTICS

<i>Parameter</i>	<i>Symbol</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
Supply voltage for logic	Vcc -Vss	2.6	2.8	3.2	V
Input Current	Idd	--	10	--	mA
Input voltage ' H ' level	Vih	0.7Vdd	--	Vdd	V
Input voltage ' L ' level	Vil	-Vss	--	0.2 Vdd	V
Output voltage ' H ' level	Voh	0.8 Vcc	--	Vcc	V
Output voltage ' L ' level	Vol	0	0	0.2 Vcc	V

4.0 BACKLIGHT CHARACTERISTICS

<i>Item</i>	<i>Symbol</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	<i>Condition</i>
Forward voltage	Vf	2.8	3.0	3.3	V	--
Luminance	Lv	--	200	--	cd/m2	If=40mA
Number of LED	--	2			Piece	--
Connection mode	P	Parallel			--	--

Using condition: constant current driving method If= 20 mA(+/-10%)



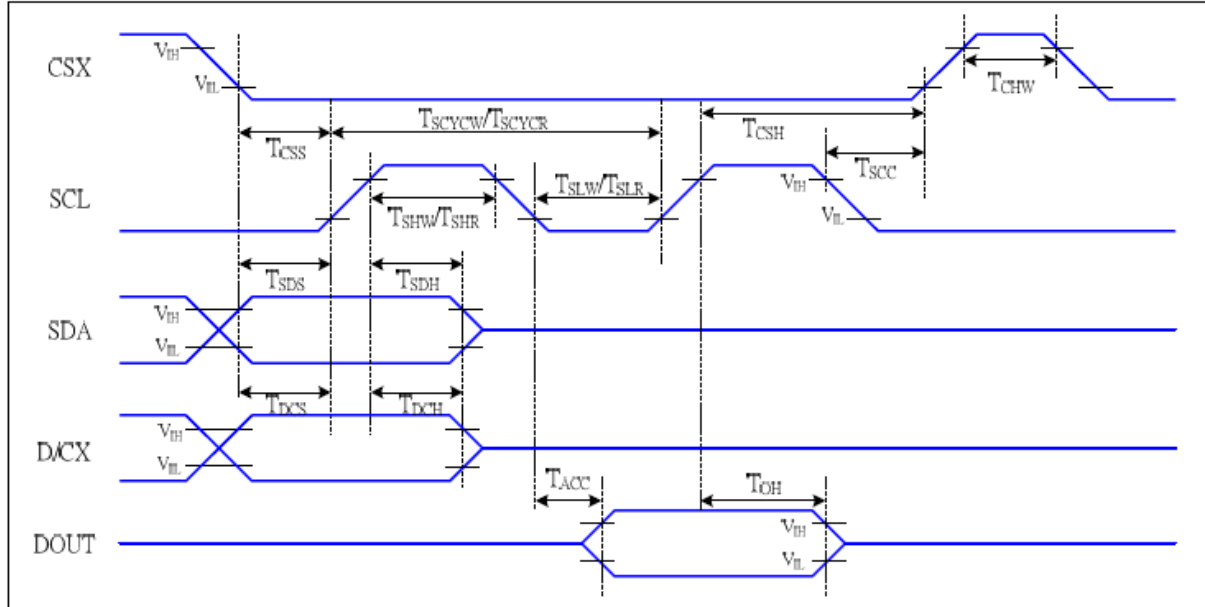
5.0 DIMENSIONAL DRAWING

6.0 INTERFACE PIN CONNECTIONS

<i>Pin.No</i>	<i>Symbol</i>	<i>Function</i>
1	LEDK	back light power supply negative
2	GND	Ground
3	FMARK	Tearing effect output pin to synchronies MCU to frame rate
4	SDA	the serial input/output signal in serial interface mode.
5	RS	Display data/command selection pin in 4-line serial interface
6	SCK	used to be serial interface clock.
7	CS	chip select signal input
8	RESET	A reset pin.
9	IOVCC18	Power Supply for I/O system.(1.8V or VCC)
10	VCC28	Power Supply for Analog, Digital System and Booster Circuit.
11	GND	Ground
12	LEDA	back light power supply positive
13~15	NC	No Connect

6.1 TIMING CHARACTERISTICS

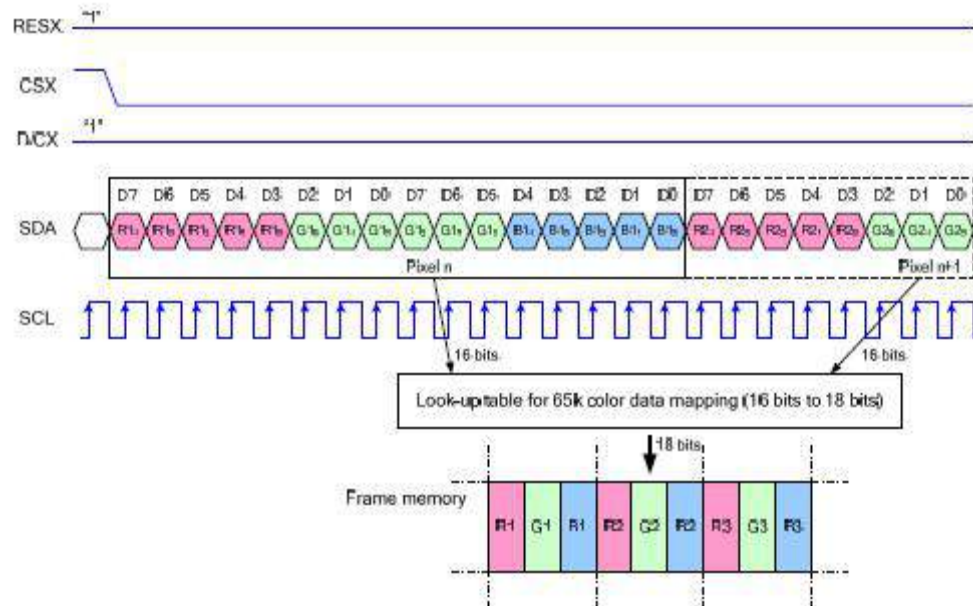
6.1.1 Serial Interface Characteristics (4-line Serial)



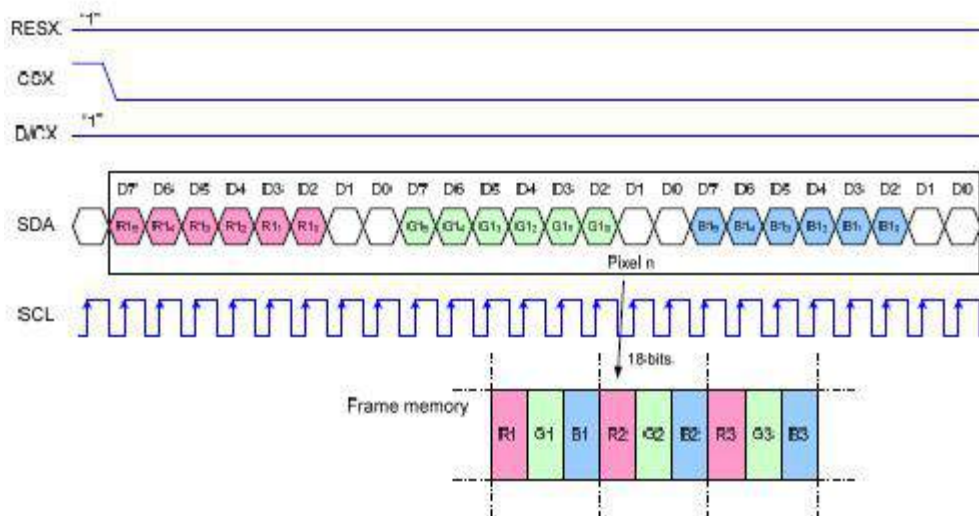
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
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)	66		ns	-write command & data ram
	T _{SHW}	SCL "H" pulse width (Write)	15		ns	
	T _{SLW}	SCL "L" pulse width (Write)	15		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 _{DCH}	D/CX setup time	10		ns	
	T _{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T _{SDS}	Data setup time	10		ns	
	T _{SDH}	Data hold time	10		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

8.8.42 Write data for 16-bit/pixel (RGB-5-6-5-bit input), 65K-Colors, 3Ah="05h"



8.8.43 Write data for 18-bit/pixel (RGB-6-6-6-bit input), 262K-Colors, 3Ah="06h"



6.2. Reset Input Timing

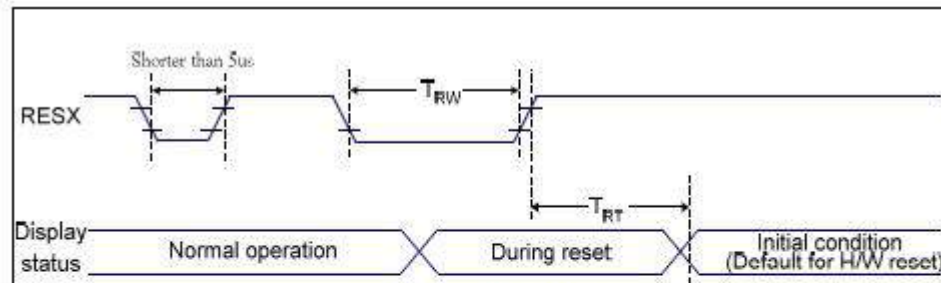


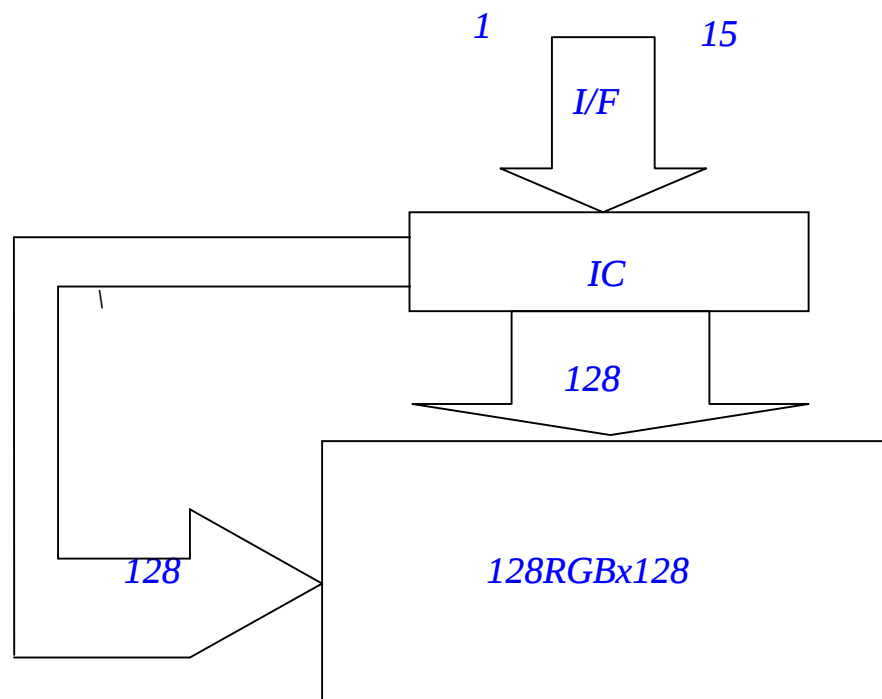
Figure 7 Reset Timing

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

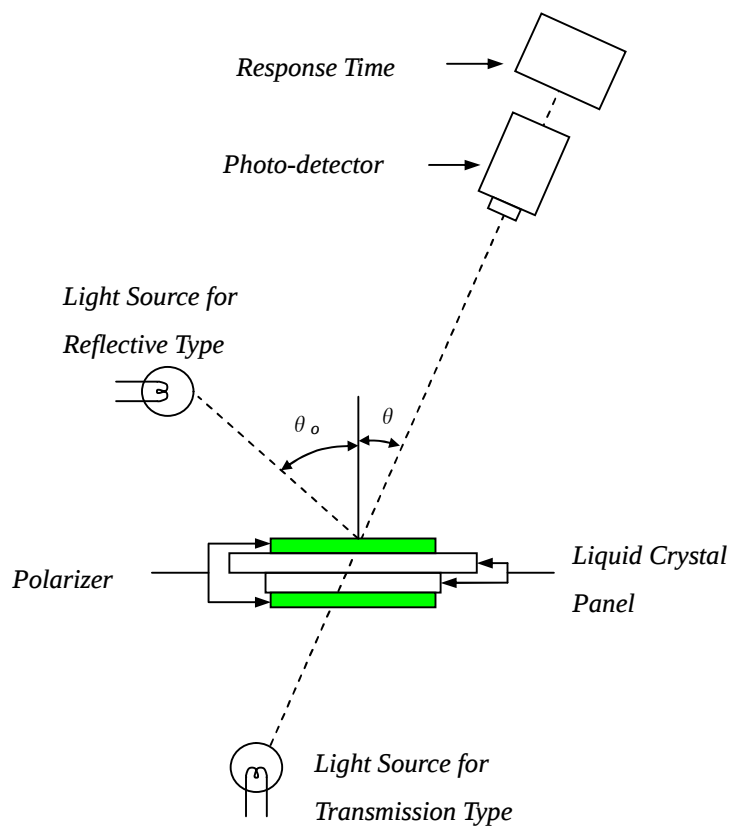
6.3 BLOCK DIAGRAM OF LCM



7. ELECTRO-OPTICAL CHARACTERISTICS

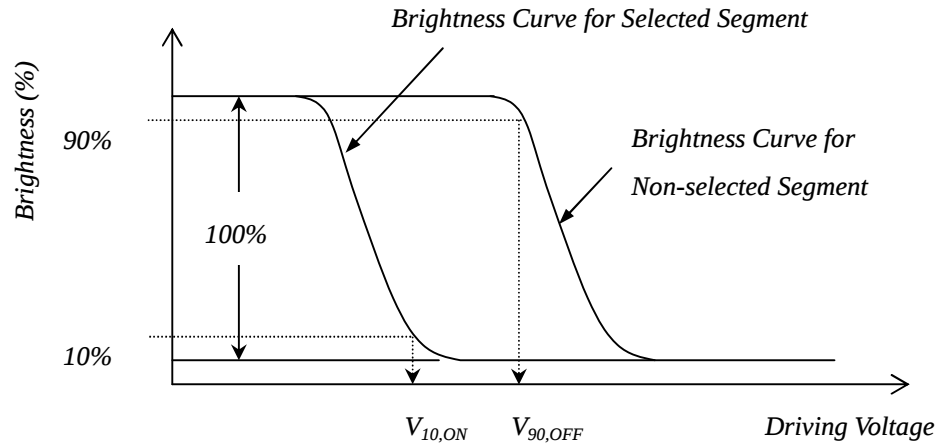
Item	Symbol	Condition	Temp	Min	Typ	Max	Units	Note
Operating Volt.	V_{LCD}	$\theta = \psi = 0$	-10 °C	----	----	----	V	8.1
			25 °C	----	8.5	----		
			60 °C	----	----	----		
Response Time	Rise Time (Tr)	$\theta = \psi = 0$	-10 °C	----	----	----	msec	8.2
	Decay Time (Td)			----	----	----		
	Rise Time (Tr)		25 °C	----	----	240		
	Decay Time (Td)			----	----	240		
	Rise Time (Tr)		60 °C	----	----	----		
	Decay Time (Td)			----	----	----		
Viewing Angle Range	θ	$\psi = 0^\circ$	25 °C	----	----	30	Deg	8.3 $CR \geq 2$
		$\psi = 90^\circ$		----	----	30		
		$\psi = 180^\circ$		----	----	30		
		$\psi = 270^\circ$		----	----	30		
Contrast Ratio	Cr	$\theta = \psi = 0$	25 °C	3	4.5	----	---	8.4

7.1 ELECTRO-OPTICAL CHARACTERISTICS TEST METHOD

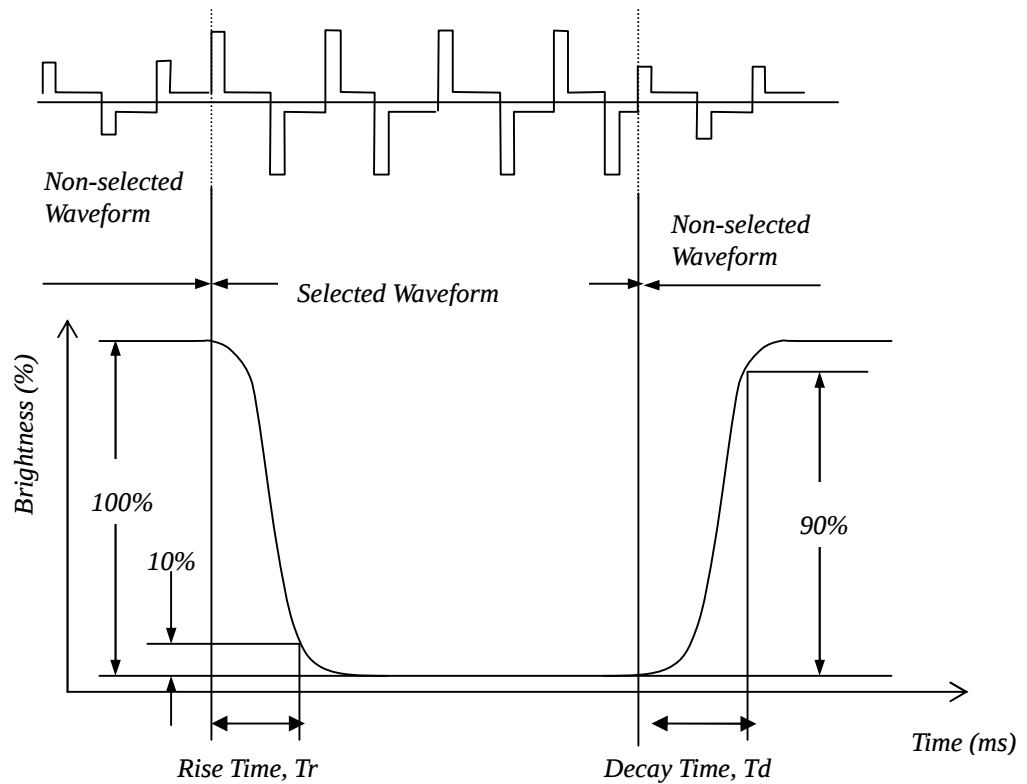


7.2 DEFINITION OF OPERATING VOLTAGE, VOP

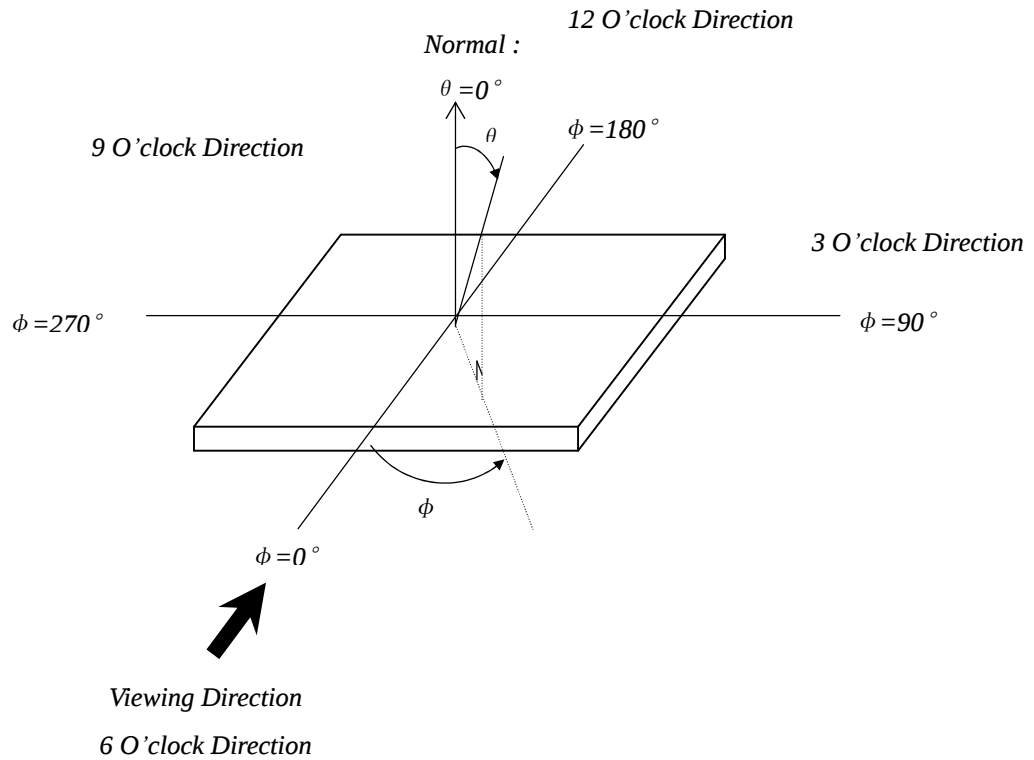
$$V_{op} = (V_{10,ON} + V_{90,OFF})/2$$



7.3 DEFINITION OF OPTICAL RESPONSE TIME

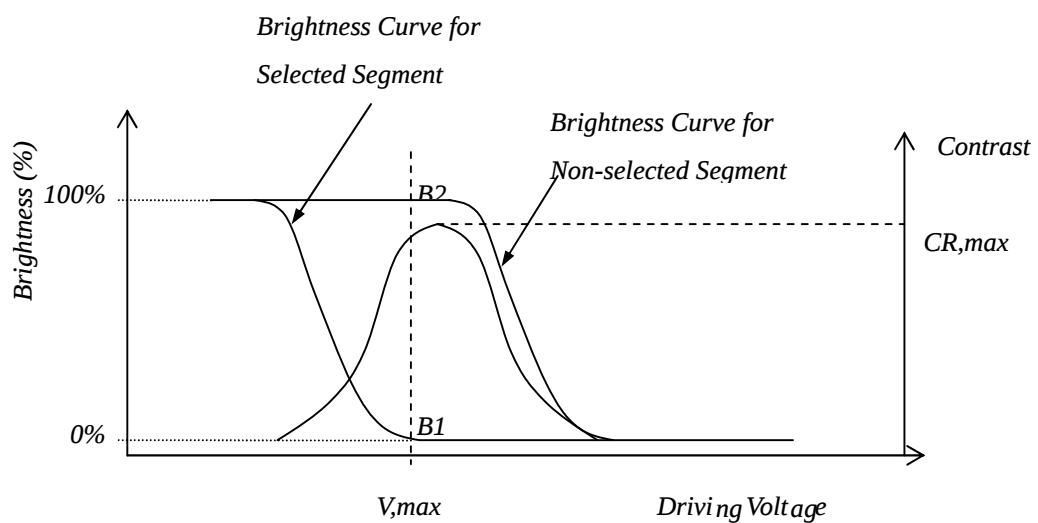


7.4 DEFINITION OF VIEWING ANGLE θ AND ϕ



7.5 DEFINITION OF CONTRAST RATIO, CR

$$CR = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$



8.INSPECTION CRITERIA

8.1 Inspection Conditions

8.1.1 Environmental conditions

The environmental conditions for inspection shall be as follows

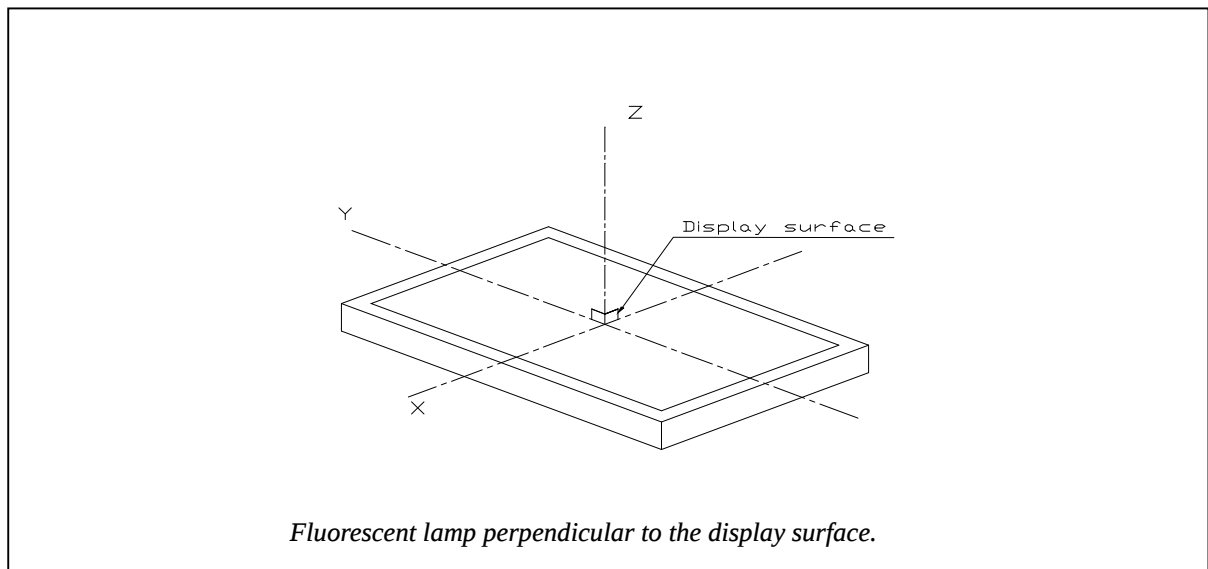
Room temperature: $20\pm 3^{\circ}\text{C}$

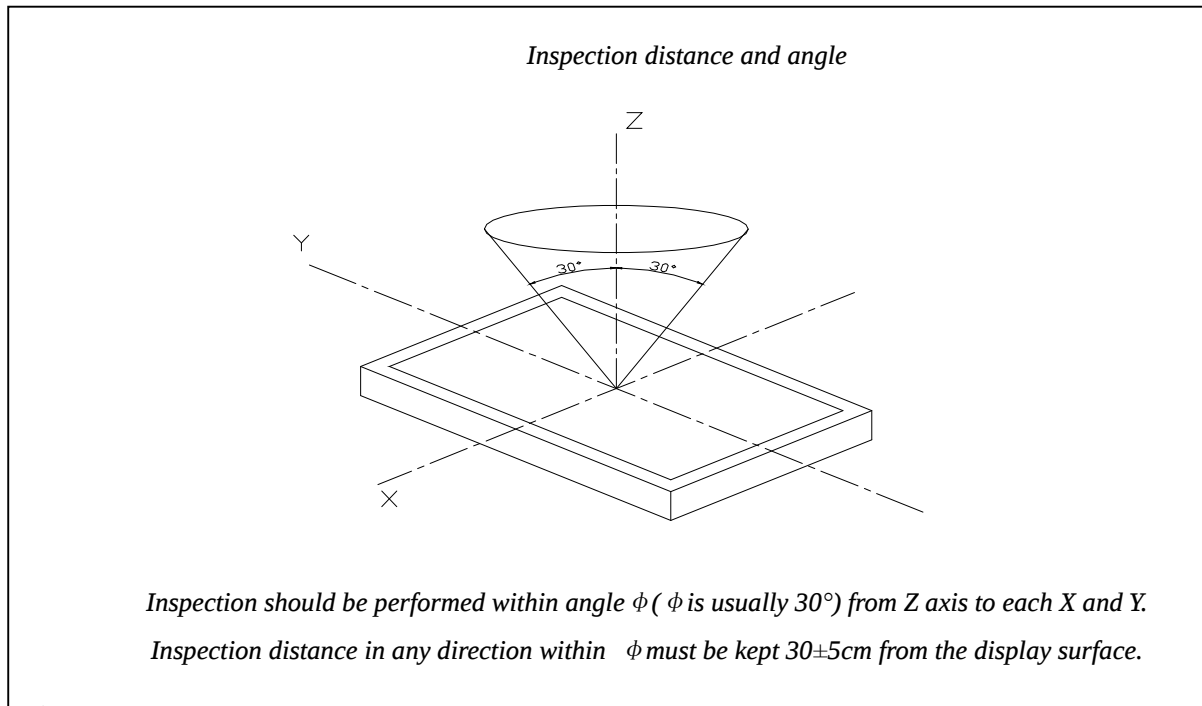
Humidity: $65\pm 20\%RH$

8.1.2 The external visual inspection

With a single 20-watt fluorescent lamp as the light source, the inspection was in the distance of 30cm or more from the LCD to the inspector's eyes .

8.2 LIGHT METHOD





8.3 Classification of defects

9.3.1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

9.3.2 Minor defect

A minor defect refers to a defect which is not considered to be able substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

9. RELIABILITY

9.1 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)

9.2 TESTS

NO.	Test Item	Test condition	Criterion
1	High Temperature Storage	80°C±2°C 96H Restore 2H at 25°C Power off	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-30°C±2°C 96H Restore 2H at 25°C Power off	
3	High Temperature Operation	70°C±2°C 96H Restore 2H at 25°C Power on	
4	Low Temperature Operation	-20°C±2°C 96H Restore 4H at 25°C Power on	
5	High Temperature & Humidity Operation	60°C±2°C 90%RH 96H Power on	
6	Temperature Cycle	--30°C ↔ 25°C ↔ 80°C 30min 5min 30min after 10cycle, Restore 2H at 25°C Power off	
7	Vibration Test	10Hz~150Hz, 100m/s ² , 120min	
8	Shock Test	Half-sinewave, 300m/s ² , 11ms	1. After testing, cosmetic and electrical defects should not happen. 2. the product should remain at initial place 3. Product uncovered or package broken is not permitted.
9	Drop Test(package state)	800mm, concrete floor, 1corner, 3edges, 6 sides each time	

10. PRECAUTIONS FOR USING LCD MODULE

10.1 handing precautions

- (1) *The display panel is made of glass. Do not subject it to a mechanical shock or impact by dropping it.*
- (2) *If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.*
- (3) *Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.*
- (4) *The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.*
- (5) *If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten a cloth with one of the following solvents:*
 - Isopropyl alcohol
 - Ethyl alcohol
- (6) *Solvents other than those above mentioned may damage the polarizer.*

Especially, do not use the following:

 - Water
 - Ketone
 - Aromatic solvents
- (7) *Extra care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment accelerates corrosion of the electrode.*
- (8) *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.*
- (9) *Do not attempt to disassemble or process the LCD Module.*
- (10) *NC terminal should be open. Do not connect anything.*
- (11) *If the logic circuit power is off, do not apply the input signals.*
- (12) *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 Module.*
 - *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.*

10.2 STORAGE PRECAUTIONS

When storing The LCD Module, avoid exposure to direct sunlight of fluorescent lamps. Keep the modules in bags (avoid high temperature/ high humidity and low temperatures below 0 °C). Whenever possible, the LCD Module should be stored in the same conditions in which they were shipped from our company.

10.3 OTHERS

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD Module have been operating for a long time showing the same display patterns the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be recovered by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD Module resulting from destruction caused by static electricity etc. exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.*
- Terminal electrode sections.*