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SPECIFICATIONS

VT028I-LT01-F08

Swissdis 111049

TFT 2.8" with Touch

Resolution 240 x 320

Version Juli 2021

ISSUE RECORD

NO.	VER.	DATE	MODIFY REASON	MODIFY CONTENTS
1	A	2021/07/01	New issued	

Contents

1. Introduction

1.1 Scope of application

This specification applies to the positive type TFT transmissive dot matrix LCD module that is supplied by Tecenstar. This LCD module should be designed for mobile phone use.

LCD specification: Dots 240xRGBx320.

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

1.2 Structure:

Module display structure:

TFT Module + FPC + BL

FULL 65k or 262k Color 2.8 inch TFT LCD size for main LCD; One bare chip with gold bump (COG) TECH;
MCU&RGB interface;

1.3 TFT features:

Structure: TFT PANNEL+IC+FPC+BL;
Transmissive Type LCD;
240 dot-source and 320 dot-gate outputs;

65k or 262k Color can be selected by software; White LED back light;
MCU&RGB interface;
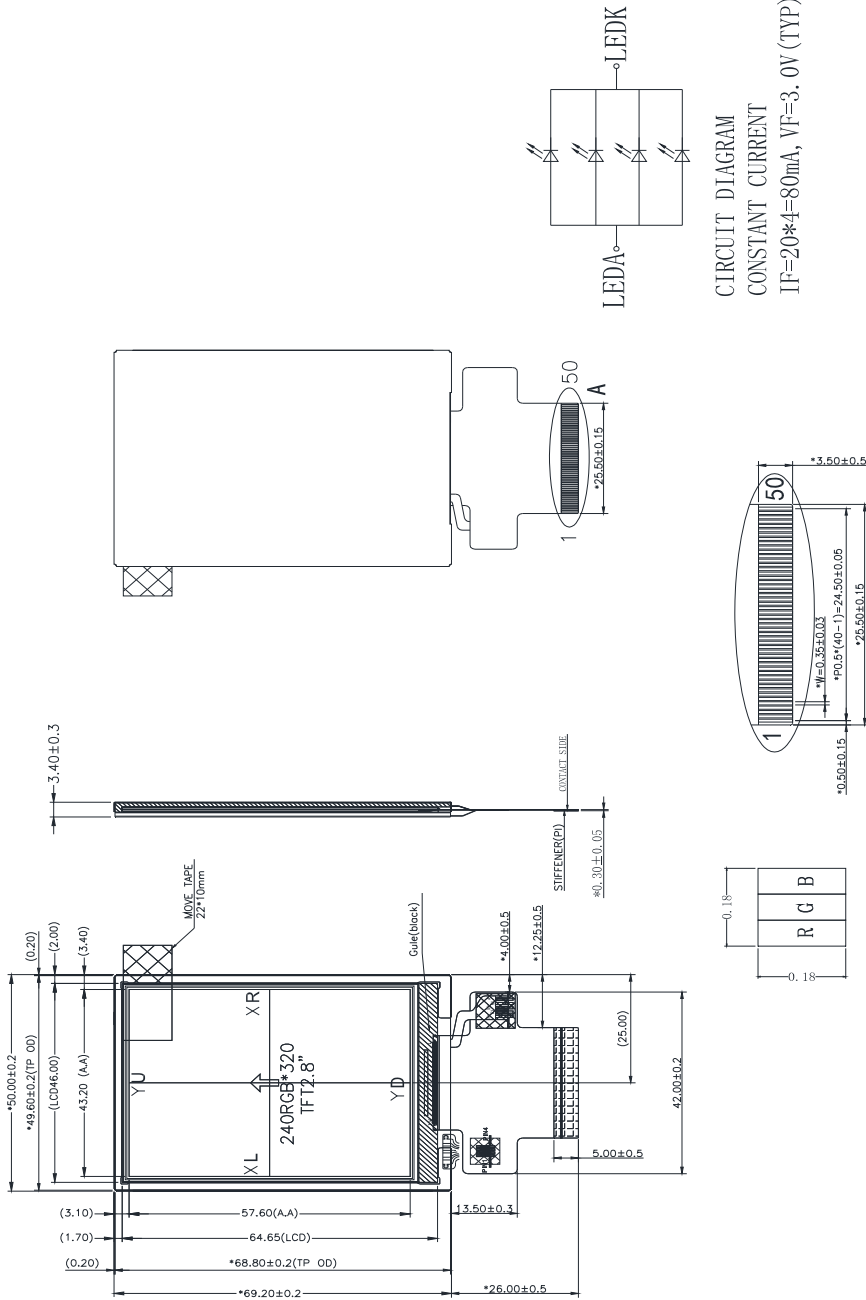
1.4 Applications:

Mobile phone
   PSP
   PDA
   GPS
   Etc…

2. **General specification**

ITEM	Standard value	UNIT
LCD Type	TFT Transmissive	---
Driver element	a-Si TFT Active matrix	
Number of Dots	240*(RGB)*320	Dots
Pixel Arrangement	RGB Vertical Stripe	
Active Area	43.2 *57.6	mm
Viewing Direction	6 O'clock	
Gray level inversion	12 O'clock	
Driver IC	ST7789V2	
Module Size(W*H*T)	50x69.2x3.4	mm
Approx. Weight	TBD	g
Back Light	White LED	
System interface	MCU&RGB interface	

3. Mechanical drawing

NO.	PIN NAME	NO.	PIN NAME
1	LEDK1	27	DB5
2	LEDK2	28	DB4
3	LEDK3	29	DB3
4	LEDK4	30	DB2
5	LEDA	31	DB1
6	IM0	32	DB0
7	IM1	33	SDO
8	IM2	34	SCI
9	IM3	35	RD
10	RESET	36	WR
11	VSYNC	37	RS
12	HSYNC	38	CS
13	DOTCLK	39	FMARK
14	ENABLE	40	IOVCC
15	DB17	41	VCI
16	DB16	42	VCI
17	DB15	43	GND
18	DB14	44	XR
19	DB13	45	YU
20	DB12	46	XL
21	DB11	47	YD
22	DB10	48	NC
23	DB9	49	NC
24	DB8	50	NC
25	DB7		
26	DB6		

CIRCUIT DIAGRAM
CONSTANT CURRENT
IF=20*4=80mA, VF=3.0V (TYP)

LEDK
LEDA

DETAIL A
SCALE 2:1

DOTS DETAIL
SCALE 100:1

R G B

240RGB*320
TFT2.8"

LCM Notes:

1.Display Siz:2.8" TFT
2.Resolution:240xRGBx320
3.Viewing Direction(Gray Scale Inversion Direction):12'CLOCK
4.Display Mode:Transmissive/normal White
5.Driver IC:ST7789V2
6.VDD:2.8V TYP
7.Brightness:300cd/m²(Typ)
8.Labeling instructions:( ) Reference dimension
9.Temperature requirements: OPERATING TEMP:-20℃~ +70℃
                              STORAGE TEMP:-30℃~ +80℃
10.Requirements on Environmental Protection:ROHS

The tolerance of non-specified dimension is ±0.3mm.

UNIT:	mm			
SCALE:				
MODEL:	T28I			REV :A
TITLE	LCM DRAWING			
DWG NO.				
APPROVE				
CHECK				
DRAW	Jane	2021/07/01		

4. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	VDD	-0.3	4.6	V
Input voltage for analog	VDDIO	-0.3	4.6	V
Supply current (One LED)	ILED		20	mA
Operating temperature	TOP	-20	+70	℃
Storage temperature	TST	-30	+80	℃

5. ELECTRICAL CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
Supply voltage for logic	VDDIO	1.65	1.8	3.3	V	V_{DD}
Input voltage for analog	VDD	2.5	2.8	3.3		
Input voltage	V_{IL}	GND	-	0.3 V_{DDIO}	V	
	V_{IH}	0.7 V_{DDIO}	-	V_{DDIO}	V	
Input leakage current	I_{LKG}				μA	
LED Forward voltage	V_f	3.0	3.2	3.4	V	With One LED
Input backlight current	I_{LED}	-	15	20	mA	With One LED

Backlight driving conditions

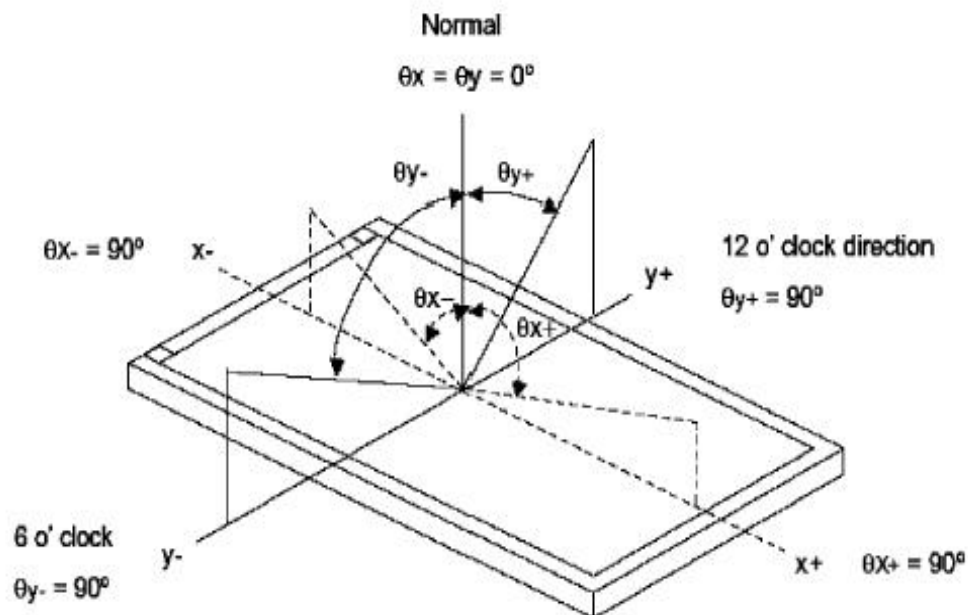| Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED backlight	V_L	3.0	3.2	3.4	V	Note 1
Current for LED backlight	I_L	-	60	80	mA	
LED life time	-	30,000	-	-	Hr	Note 2

Note 1： The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I_L =60mA.

Note 2： The "LED lift time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and I_L =60mA. The Led lifttime could be decrease if operating It is Lager than 80mA.

6. OPTICAL CHARACTERISTICS

| ITEM		SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE
				MIN.	TYP.	MAX		
Brightness		B		150	240	--	Cd/m^2	
Contrast Ratio		CR		300	500	--	--	
Response Time		Tr+Tf			20	30	ms	
CIE Color coordinate	Red	X_R	Viewing normal angle	--	--			All left side data are based on CMI's product reference only
		Y_R			--			
	Green	X_G		--	--			
		Y_G			--			
	Blue	X_B		--	--			
		Y_B			--			
	White	X_W		0.21	0.266	0.32		
		Y_W		0.215	0.270	0.32		
Viewing Angle	Hor.	θ_{X+}	Center CR>=10	30	45	--	Deg.	
		θ_{X-}		30	45	--		
	Ver.	θ_{Y+}		30	45	--		
		θ_{Y-}		10	20			
Uniformity		Un		70	80		%	

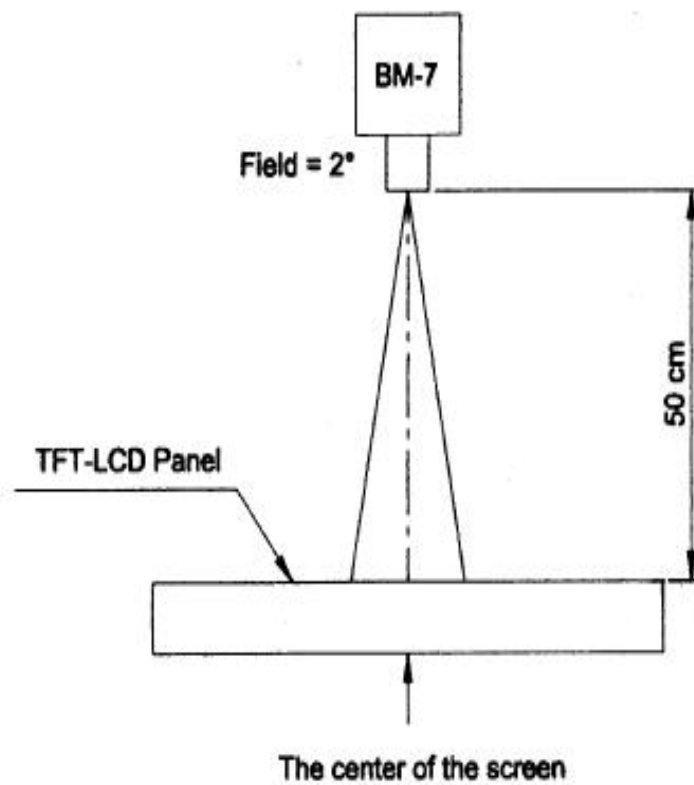Note 1 : Definition of Viewing Angleθ_X andθ_Y :

Note 2: Definition of contrast ratio CR:

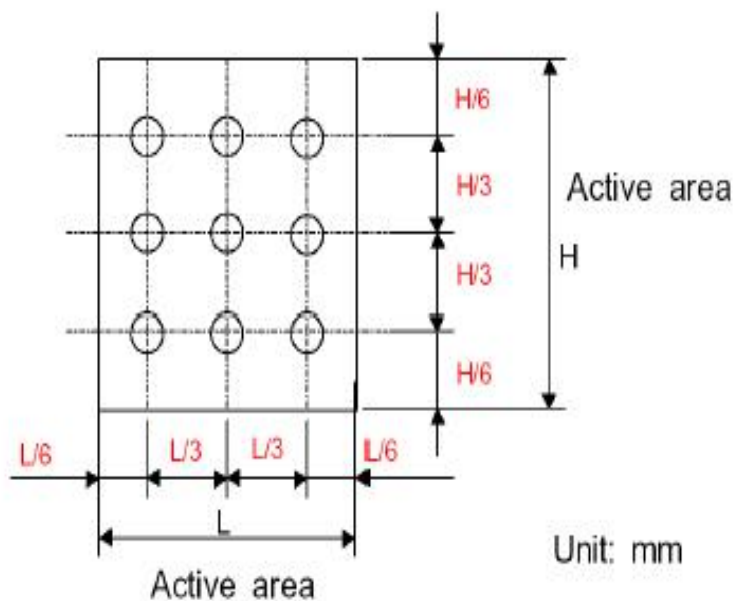$$CR= \frac{\text{Brightness of non-selected dots (white)}}{\text{Brightness of selected dots (black)}}$$

Note 3: Definition of response time (T_R, T_F)
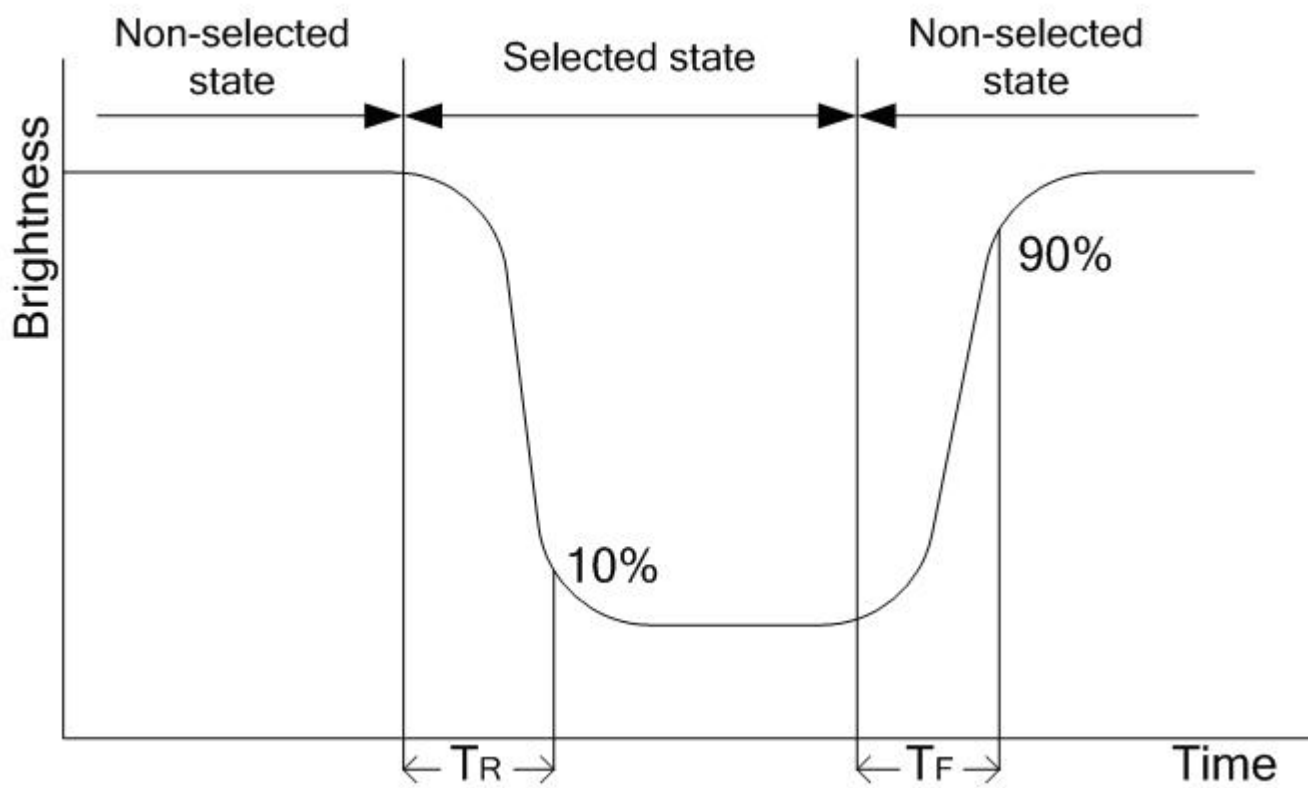
: The brightness test equipment setup

20mA Field=2° (As measuring "black" image, field=2° is the best testing condition)

The center of the screen

Note 4 :

Unit: mm

7. MCU Interface Pin Function

Pin No.	Symbol	Description
1	LED_K1	Cathode of LED back light.
2	LED_K2	Cathode of LED back light.
3	LED_K3	Cathode of LED back light.
4	LED_K4	Cathode of LED back light.
5	LED_A	Anode of LED back light.
6	IM0	Note
7	IM1	Note
8	IM2	Note
9	IM3	Note
10	RESET	reset pin. Initializes the ST7789V2 with a low input. Be sure to execute a power-on reset after supplying power.
11	VSYNC	Vertical sync signal
12	HSYNC	Horizontal sync signal
13	DOTCLK	Dot clock signal
14	ENABLE	Display enable pin
15	DB17	Data bus
16	DB16	Data bus
17	DB15	Data bus
18	DB14	Data bus
19	DB13	Data bus
20	DB12	Data bus
21	DB11	Data bus
22	DB10	Data bus
23	DB9	Data bus
24	DB8	Data bus
25	DB7	Data bus
26	DB6	Data bus
27	DB5	Data bus
28	DB4	Data bus
29	DB3	Data bus
30	DB2	Data bus
31	DB1	Data bus

.

32	DB0	Data bus
33	SDO	Serial data output
34	SDI	Serial data input
35	RD	Read data signal
36	WR	A write strobe signal and enables an operation to write data when the signal is low..
37	RS	A register select signal. Low: select an index or status register, High: select a control regis
38	CS	A chip select signal. Low: the ST7789V2 is selected and accessible. High: the ST7789V2 is not selected and not accessible
39	FMARK	Tearing effective signal control
40	IOVCC	Power supply for logic voltage.
41	VCI	Power supply for analog voltage.
42	VCI	Power supply for analog voltage.
43	GND	Power ground
44	XR	Touch panel X right line
45	YU	Touch panel Y up line
46	XL	Touch panel X Left line
47	YD	Touch panel Y down line
48	NC	No connect
49	NC	No connect
50	NC	No connect

NOTE

| IM3	IM2	IM1	IM0	MPU Interface Mode	Data pin
0	0	0	0	80-8bit parallel I/F	DB[7:0]
0	0	0	1	80-16bit parallel I/F	DB[15:0]
0	0	1	0	80-9bit parallel I/F	DB[8:0]
0	0	1	1	80-18bit parallel I/F	DB[17:0],
0	1	0	1	3-line 9bit serial I/F	SDA: in/out
				2 data lane serial I/F	SDA: in/out WRX: in
0	1	1	0	4-line 8bit serial I/F	SDA: in/out
1	0	0	0	80-16bit parallel I/F Ⅱ	DB[17:10], DB[8:1]
1	0	0	1	80-8bit parallel I/F Ⅱ	DB[17:10]
1	0	1	0	80-18bit parallel I/F Ⅱ	DB[17:0],
1	0	1	1	80-9bit parallel I/F Ⅱ	DB[17:9]
1	1	0	1	3-line 9bit serial I/F Ⅱ	SDA: in/ SDO: out
1	1	1	0	4-line 8bit serial I/F Ⅱ	SDA:in/ SDO: out

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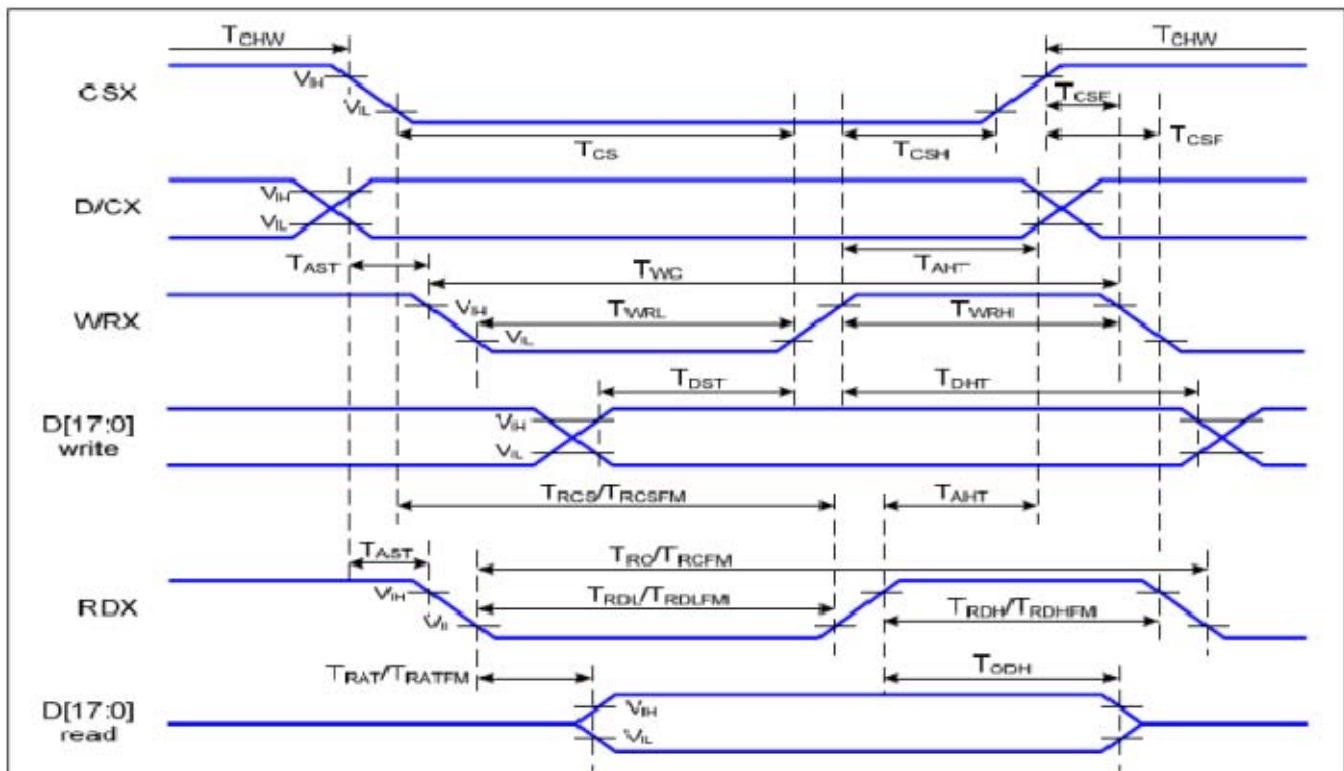
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
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

8. BLOCK DIAGRAM
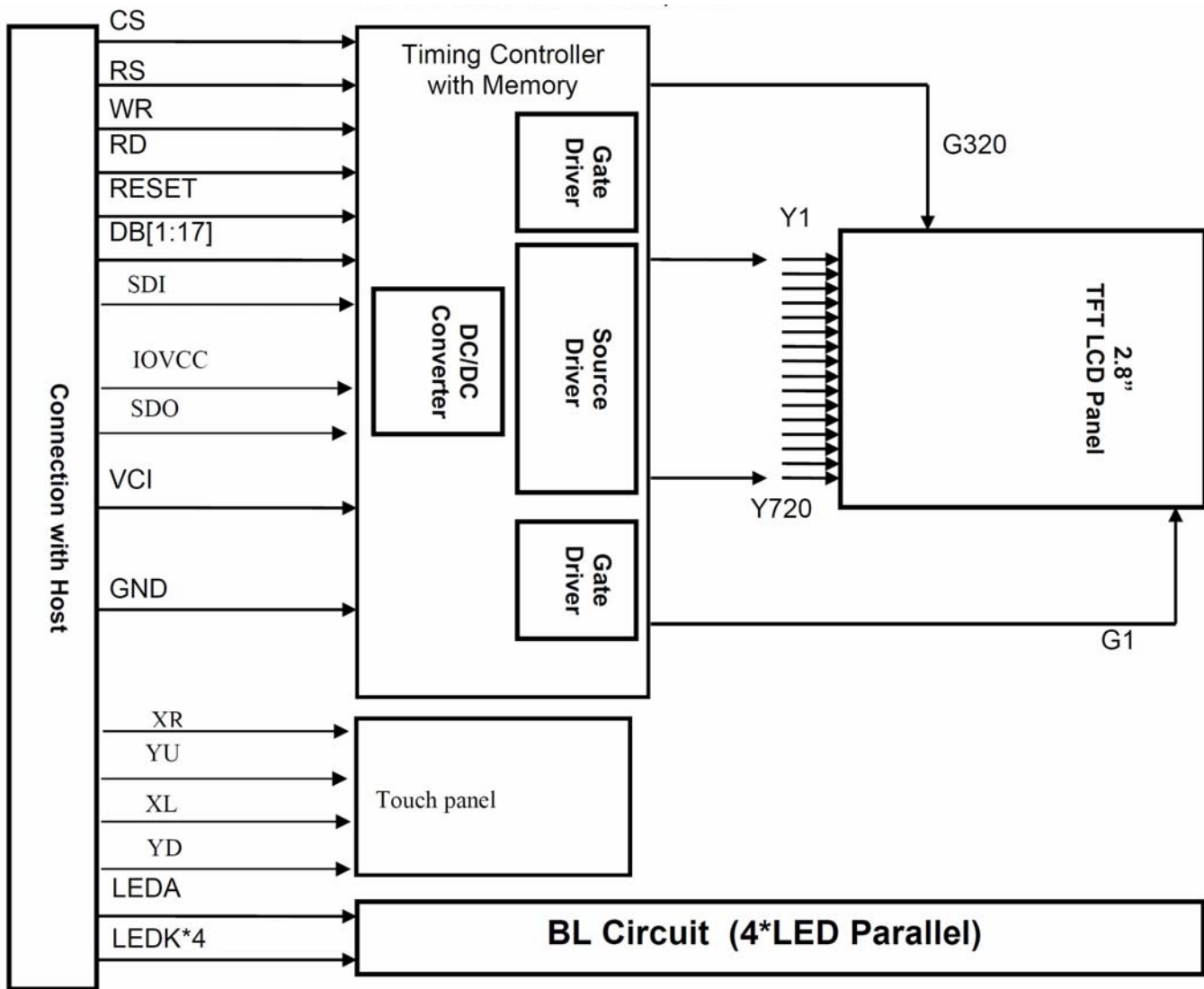
9. Touch Screen Panel Specifications

9.1 Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	100	-	550	Ω	X(Film side)
	250	-	950	Ω	Y(Glass side)
Insulation resistance	20	-	-	MΩ	DC 25V
Voltage	3	-	10	V	1mA
Response time	-	15	-	ms	
Transparency	-	80	-	%	Non-glare
Surface hardness	3H	-	-		Pencil

Caution (1) : Do not operate it with a thing except a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

9.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation force	60		120	g	(1)
Hitting Durability	1,000,000	-	-	times	(2)
Sliding Durability	100,000			times	(3)
Surface hardness	3	-	-	H	JIS K5400

Note (1)   Input : Finger or polyacetal pen 0.8R
Note (2) Hit 1,000,000 times on the Film with a placenta (POM) pencil (R0.8)
 - Force: 250gf
  - Speed: 2times/sec
Note (3) Shuttle 10,000 times with a placenta (POM) pencil (R0.8)
  - Force: 150gf
  - Speed: 60mm/sec

10. Standard Specification for Reliability

10–1. Standard Specifications for Reliability of LCD Module

No	Item	Description
01	High temperature operation	The sample should be allowed to stand at 70℃ for 240 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
02	Low temperature operation	The sample should be allowed to stand at -20℃ for 240 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
03	High temperature storage (nonoperation)	The sample should be allowed to stand at 80℃ for 240 hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 2 hours.
04	Low temperature storage (nonoperation)	The sample should be allowed to stand at -30℃ for 240 hours under no-load condition, then returning it to normal temperature condition, and allowing it stand for 2 hours.
05	Moisture storage (nonoperation)	The sample should be allowed to stand at 60℃,90%RH MAX for 240 hours under no-load condition, then taking it out and drying it at normal temperature for 2 hours.
06	Thermal shock storage (nonoperation)	The sample should be allowed to stand the following 10 cycles : -30℃ for 30 minutes → normal temperature for 5 minutes → +80℃ for 30 minutes → normal temperature for 5 minutes, as one cycle.
07	Packing vibration	Frequency range : 10Hz ~ 55Hz Amplitude of vibration : 1.5mm Sweep time: 12 min X,Y,Z 2 hours for each direction
08	Packing drop test	Height:80 cm, 1 corner, 3 edges, 6 surfaces
09	Electrical Static Discharge	Air: ±8KV 150pF/330Ω 5 times(Test together with enclosure)
		Contact: ±2KV 150pF/330Ω 5 time

*Sample size for each test item is 3~5pcs
    10.2. Testing Conditions and Inspection Criteria

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in Table 9.2, Standard specifications for Reliability have been executed in order to ensure stability.

No	Item	Test Model	In section Criteria
01	Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
02	Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
03	Appearance	Visual inspection	Defect free.

11. Specification of Quality Assurance:

11.0. Purpose

This standard for Quality Assurance should affirm the quality of LCD module products to supply to purchaser by TeCenTer

11.2. Standard for Quality Test

a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

b.Electro-Optical Characteristics:

According to the individual specification to test theproduct.

c. Test of Appearance Characteristics:

According to the individual specification to test the product.

d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level Ⅱ take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

11.3. Non- conforming Analysis & Deal With Manners

a. Non- conforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of non- conforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before 3 days.

b. Disposition of non- conforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of non- conforming when the reason of nonconforming is not sure.

11.4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides should think that must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

c. Any other special problem.

11.5. Basic conditions for inspection

    11.5.1 . Inspection performed under the following conditions is recommended.

        Temperature : 25±5℃

        Humidity :　65%±10%RH

        Viewing Angle : Normal viewing Angle.

        Illumination: Single fluorescent lamp (500 to 700Lux)
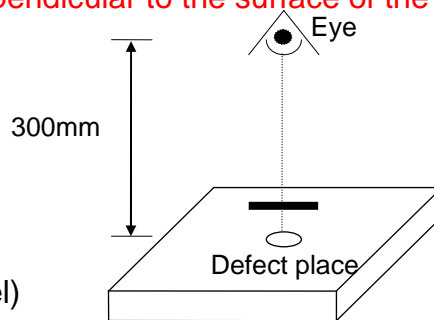
        Viewing distance:30±5cm

   11.5.2 Inspection time:

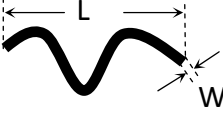   Perceptibility Test Time: 20 seconds max.

Viewing Angle:

     The vision of inspector should be perpendicular to the surface of the Module

Eye

300mm

Defect place

(1) LCM electrical criterion (Without Touch Panel)

No	Defect	Criteria		Remark	
1	No display (Major)	Not allowed			
2	Missing line (Major)	Not allowed			
3	Darker or lighter line (Major)	Not allowed			
4	Weak line (Minor)	By limit sample			
5	Bright / Dark point (Minor)	Spec.	Permissible Qty	1:1sub-pixel: 1R or 1G or 1B 2:Point defect area≧1/2 sub pixel. NOTE 1,2	
		Bright point	1		
		Dark point	2		
		Total Bright and Dark point	2		
6	Round type (Minor) (Particle、Scratch and Bubbles)	Spec.	Permissible Qty	Disregard if out of A.A.	
		D≦0.10mm	Ignored		
		0.10mm<D≦ 0.4mm	2		
		D＞0.40mm	0		

7	Line type (Minor)		Spec.	Permissible Qty	1. L: Length, W: Width 2. Disregard if out of A.A.
			W≦0.01mm	Ignored	
			L≦3.0mm and 0.01mm<W≦0.05mm	3	
			W>0.05mm or L>3.0mm	0	
8	Bubble in Cell		It should be found by eyes		Minor
	Bezel	Scratch	No harm		Minor
		Dirt			Minor
		Wrap	No harm		Minor
		Sunken	No harm		Minor
	Label	No label	No		Minor
		Inverted			Minor
		Broken			Minor
		Dirt	Word can be read.		Minor
		Not clear	No		Minor
		Word out			Minor
		Mistake	No		Minor
		Position	Be attached on right position		Minor
	Screw	Not	No		Minor
		Limp	No		Minor
Connector		Connectio	No bend on pins and damage		Minor
FPC/FFC		Broken	No		Minor

Note: 1: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

Note 2: There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

12. Handling Precaution:

11.1 Handling of LCM

- Don't give external shock.
- Don't apply excessive force on the surface.
- Liquid in LCD is hazardous substance. Must not lick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.
- Don't operate it above the absolute maximum rating.
- Don't disassemble the LCM.
- The operators should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads,the copper leads on the PCB and the interface terminals with any parts of the human body.
- The modules should be kept in antistatic bags or other containers resistant to static for storage. •
The module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

11.2 Storage

- Store in an ambient temperature of 25±10℃, and in a relative humidity of 50±10%RH. Don't expose to sunlight or fluorescent light.
- Storage in a clean environment, free from dust, active gas, and solvent.
- Store in anti-static electricity container.
- Store without any physical load.

11-3 Soldering

- Use only soldering irons with proper grounding and no leakage.
- Iron: No higher than 280±10℃ and less than 3 sec during Hand soldering.
- Rewiring: no more than 2 times.

13. Packing method

------TBD