Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 240320B1 VTH-PW

2,0“ transfl. TFT

Product Specification

Version: 0

14.10.2024

Revision History

Date	Rev. No.	Page	Summary
14.10.2024	0	ALL	FIRST ISSUE

Contents

* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorph ous silicon TFT as a switching device. This module is composed of a Transflective type TFT-LCD Panel, driver circuit,back-light unit. The resolution of a 2.0 " TFT-LCD contains 240x320 pixels, and can display up to 65K/262K colors.

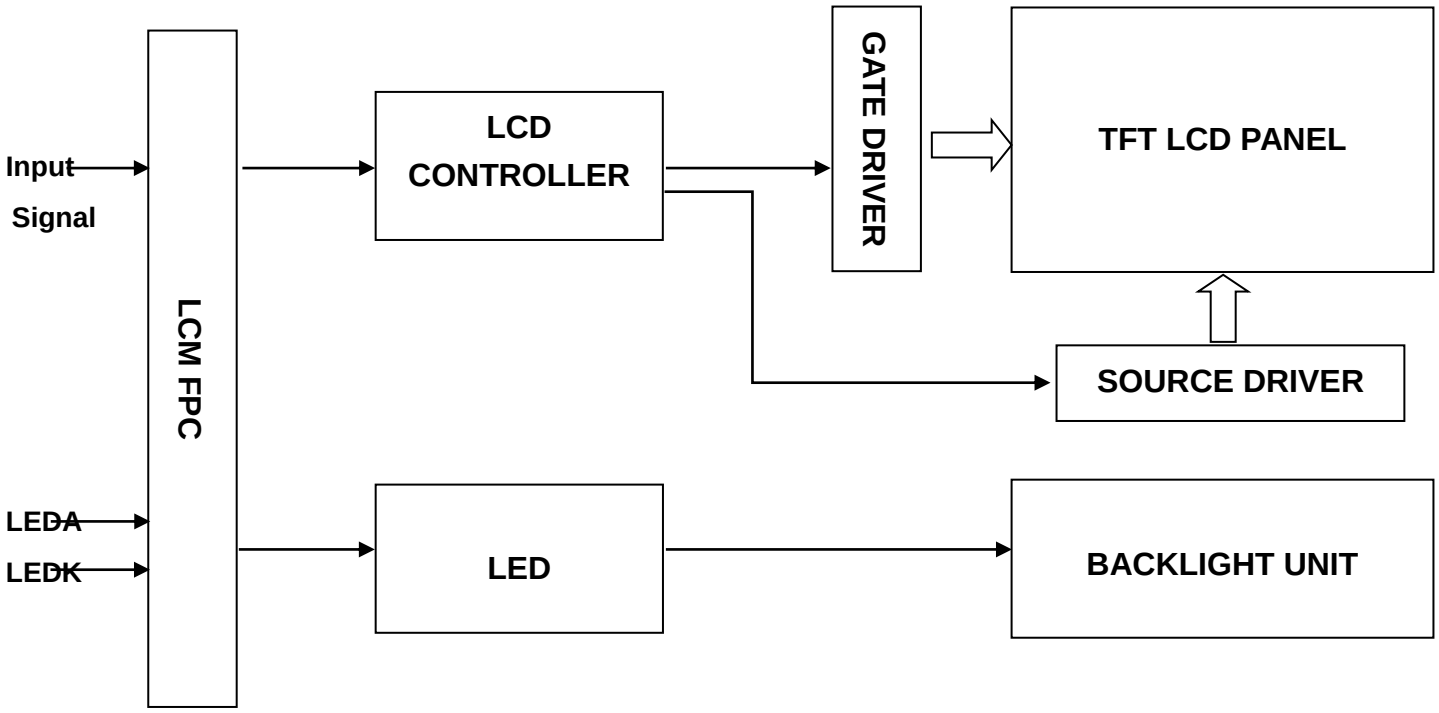
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	30.60(H)*40.80(V) (2.0 inch)	mm	
Driver element	TFT active matrix	-	
Display colors	65K/262K	colors	
Number of pixels	240(RGB)*320	dots	
Pixel arrangement	RGB vertical stripe	-	
Pixel pitch	0.1275(H)*0.1275(V)	mm	
Viewing angle	WIDE VIEWING	o'clock	
Controller IC	ST7789	-	
LCM Interface	3/4serial 8/9/16/18bit MCU 3/4SPI+16/18BIT RGB	-	
Display mode	Transflective /Normally Black	-	
Operating temperature	-20～+70	℃	
Storage temperature	-30～+80	℃	

* Mechanical Information

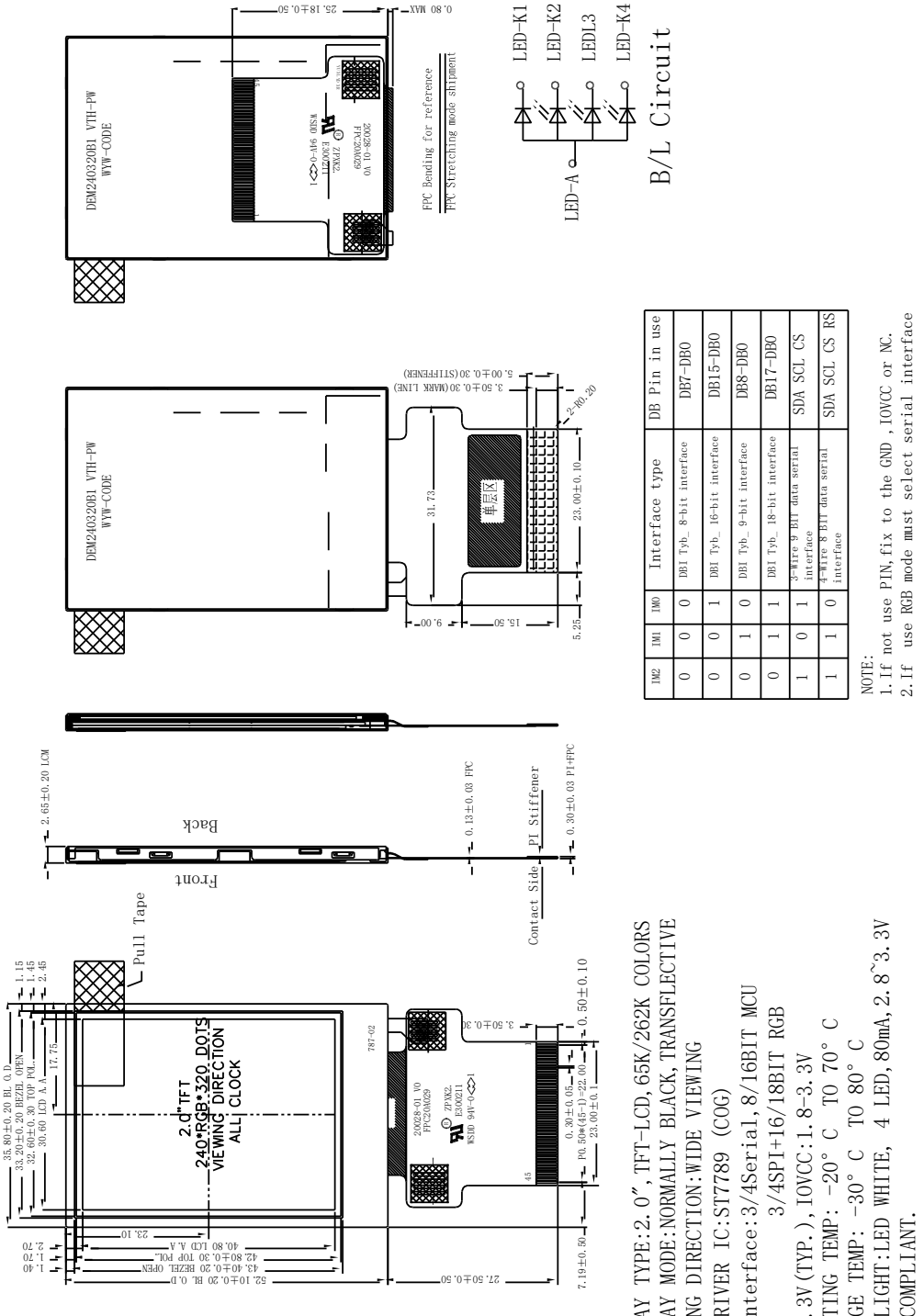
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	35.80	-	mm	
	Vertical(V)	-	52.10	-	mm	
	Depth(D)	-	2	-	mm	
Weight		-	10	-	g	

1. Block Diagram



2. Outline dimension

NO.	Pin Name
1	GND
2	VCI
3	IOVCC
4	IM2
5	IM1
6	IM0
7	RESET
8	CS
9	DC/SPI-SCL
10	WR/(SPI-RS)
11	RD
12	VSYNC
13	HSYNC
14	ENABLE
15	DOTCLK
16	SDA
17	DB0
18	DB01
19	DB02
20	DB03
21	DB04
22	DB05
23	DB06
24	DB07
25	DB08
26	DB09
27	DB10
28	DB11
29	DB12
30	DB13
31	DB14
32	DB15
33	DB16
34	DB17
35	SDO
36	LEDA
37	LEDK1
38	LEDK2
39	LEDK3
40	LEDK4
41	XR(NC)
42	YU(NC)
43	XL(NC)
44	YD(NC)
45	GND



IM2	IM1	IM0	Interface type	DB Pin in use
0	0	0	DBI Tyb_ 8-bit interface	DB7-DB0
0	0	1	DBI Tyb_ 16-bit interface	DB15-DB0
0	1	0	DBI Tyb_ 9-bit interface	DB8-DB0
0	1	1	DBI Tyb_ 18-bit interface	DB17-DB0
1	0	1	3-Wire 9 BIT data serial interface	SDA SCL CS
1	1	0	4-Wire 8 BIT data serial interface	SDA SCL CS RS

NOTE:
1. If not use PIN, fix to the GND , IOVCC or NC.
2. If use RGB mode must select serial interface

NOTE:
1. DISPLAY TYPE:2.0", TFT-LCD, 65K/262K COLORS
2. DISPLAY MODE:NORMALLY BLACK, TRANSFLECTIVE
3. VIEWING DIRECTION:WIDE VIEWING
4. LCM DRIVER IC:ST7789 (COG)
   LCM Interface:3/4Serial,8/16BIT MCU
   3/4SPI+16/18BIT RGB
5. VDD:3.3V(TYP.), IOVCC:1.8~3.3V
6. OPERATING TEMP: -20° C TO 70° C
   STORAGE TEMP: -30° C TO 80° C
7. BACK LIGHT:LED WHITE, 4 LED, 80mA, 2.8~3.3V
8. RoHS COMPLIANT.

3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	GND	Ground.	P
2	VCI	Supply voltage (3.3V).	P
3	IOVCC	Supply voltage (1.65-3.3V).	P
4	IM2	MPU Parallel interface bus and serial interface select If use RGB Interface must select serial interface. Fix this pin at IOVCC and GND.	I
5	IM1		
6	IM0		
7	RESET	This signal will reset the device and must be applied to properly initialize the chip.	I
8	CS	Chip select input pin (“Low” enable). fix this pin at GND when not in use.	I
9	DC(SPI-SCL)	-Display data/command selection pin in parallel interface. -This pin is used to be serial interface clock. DC=’1’: display data or parameter. DC=’0’: command data. -If not used, please fix this pin at GND.	I
10	WR(SPI-RS)	-Write enable in MCU parallel interface. - Display data/command selection pin in 4-line serial interface. - Second Data lane in 2 data lane serial interface. -If not used, please fix this pin at GND.	I
11	RD	Serves as a read signal and MCU read data at the rising edge. fix this pin at IOVCC or GND when not in use.	I
12	VSYNC	Frame synchronizing signal for RGB interface operation. fix this pin at GND when not in use.	I
13	HSYNC	Line synchronizing signal for RGB interface operation. fix this pin at GND when not in use.	I

14	ENABLE	Data enable signal for RGB interface operation. fix this pin at GND when not in use.	I
15	DOTCLK	Dot clock signal for RGB interface operation. Fix this pin at GND when not in use.	I
16	SDA	Serial input signal. The data is latched on the rising edge of the SCL signal. fix this pin at GND when not in use.	I
17 - 34	DB0-DB17	18-bit parallel bi-directional data bus for MCU system and RGB interface mode . Fix to GND level when not in use	I/0
35	SDO	SPI interface output pin. -The data is output on the falling edge of the SCL signal. -If not used, let this pin open.	O
36	LEDA	Anode pin of backlight	P
37	LEDK1	Cathode pin OF backlight	P
38	LEDK2	Cathode pin OF backlight	P
39	LEDK3	Cathode pin OF backlight	P
40	LEDK4	Cathode pin OF backlight	P
41	XR(NC)	Touch panel Right Glass Terminal	A/D
42	YU(NC)	Touch panel Top Film Terminal	A/D
43	XL(NC)	Touch panel LEFT Glass Terminal	A/D

44	YD(NC)	Touch panel Bottom Film Terminal	A/D
45	GND	Ground.	P

4. LCD Optical Characteristics

4.1 Transmissive mode

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.
Transmittance(With Polarizer)		T%	--	--	2.0	--	%
Contrast Ratio		CR	Θ=0 Normal viewing angle	200	250	--	
Response time	Rising	$T_{R+}T_F$		--	25	50	msec
	Falling						
Color Gamut		S(%)		45	50	--	%
Color Filter Chromacicity	White	W_X		-0.04	0.2693	+0.04	
		W_Y			0.2921		
	Red	R_X			0.5708		
		R_Y			0.3370		
	Green	G_X			0.3197		
		G_Y			0.5652		
	Blue	B_X			0.1522		
		B_Y			0.0816		
Viewing angle	Hor.	ΘL	CR>10	60	80	--	
		ΘR		60	80	--	
	Ver.	ΘU		60	80	--	
		ΘD		60	80	--	
Option View Direction		WIDE VIEWING					

4.2 Reflective mode (Not driving the back light condition)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Not
Reflection Ratio (With Polarizer)		R (θ = Φ = 0°)	--	--	7	--	%	
Reflective Contrast Ratio		CR(θ =0°)	--	--	5	--		
Viewing angle	Hor.	ΘL	CR≥ 2	--	45	--		
		ΘR		--	45	--		

	Ver.	ΘU		--	45	--		
		ΘD		--	45	--		

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

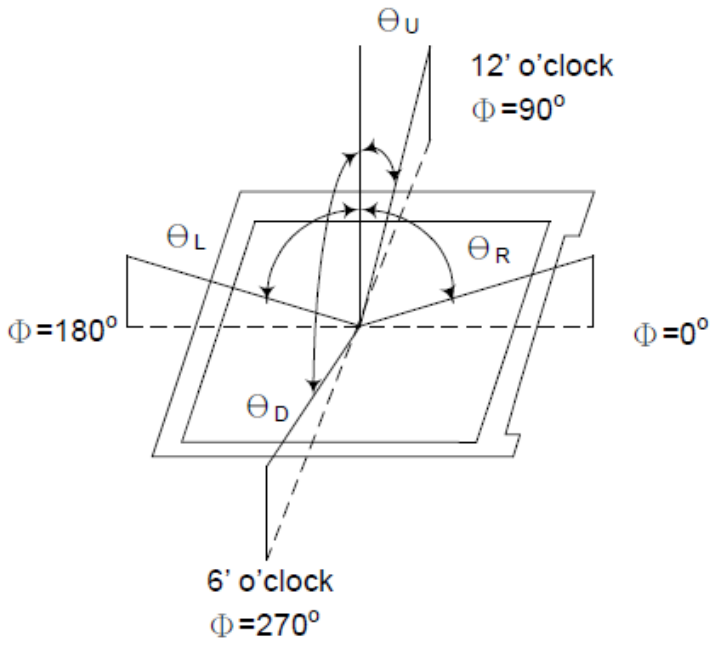
Ambient temperature : 25±2oC

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.

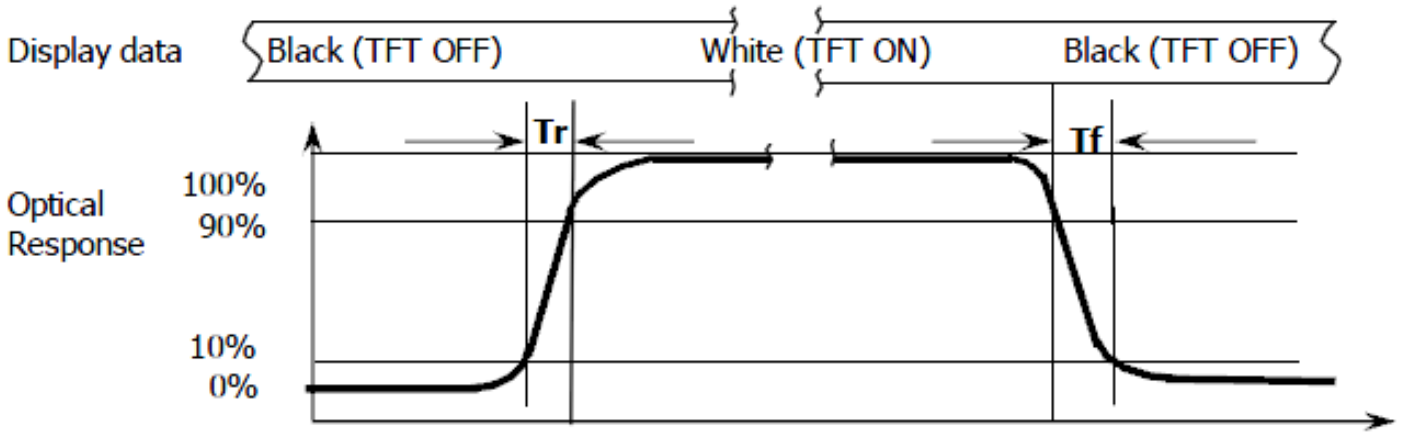
Note (1): Definition of Viewing Angle :



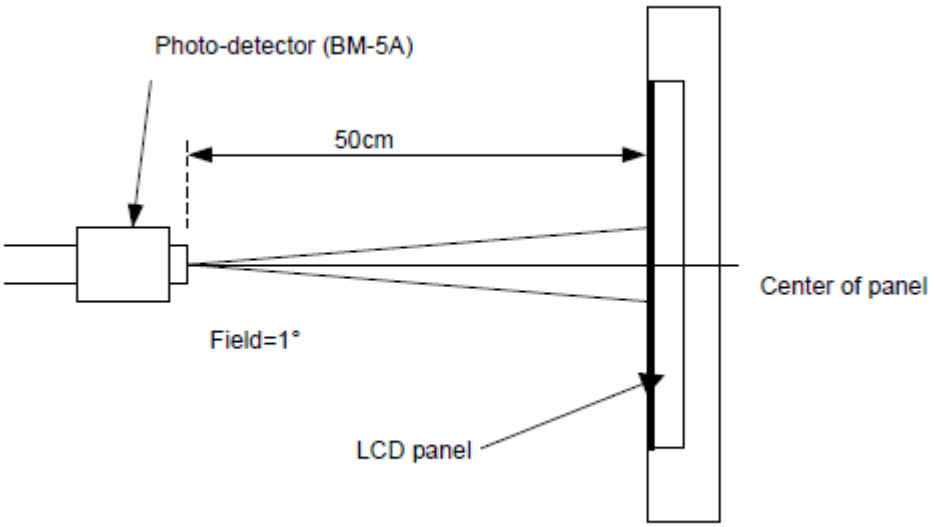
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

Note (3): Response Time



Note (4): Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VCI	-0.3	4.6	**V**
Digital interface supple Voltage	IOVCC	-0.3	4.6	**V**
Operating temperature	T_{OP}	-20	+70	°C
Storage temperature	T_{ST}	-30	+80	°C

NOTE1: 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.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VCI	2.5	3.3	3.6	V	
Digital interface supple Voltage	IOVCC	1.65	1.8	3.3	V	
Normal mode Current consumption	IDD	--	6	12	mA	
Level input voltage	V_{IH}	0.7IOVCC		IOVCC	V	
	V_{IL}	GND		0.3IOV	V	

				CC		
Level output voltage	V_{OH}	0.8IOVCC		IOVCC	V	
	V_{OL}	GND		0.2IOVCC	V	

5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 4 chips LED

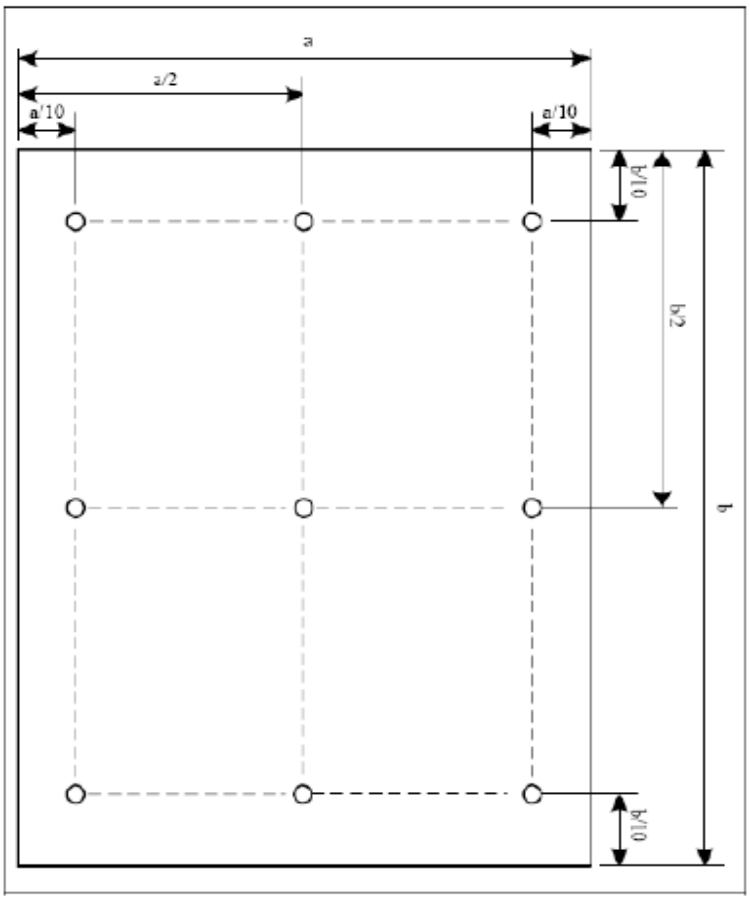
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	60	80	--	mA	
Forward Voltage	V_F	2.8	3.2	3.3	V	
LCM Luminance	LV	200	260	--	cd/m2	IF=80mA
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	Avg	80	--	--	%	Note3

Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=80mA. The LED lifetime could be decreased if operating IL is larger than 80mA. The constant current driving method is suggested.

Note (3) Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

6. AC Characteristic

6.1 8080 Series MCU Parallel Interface Timing Characteristics: 18/16/9/8-bit Bus

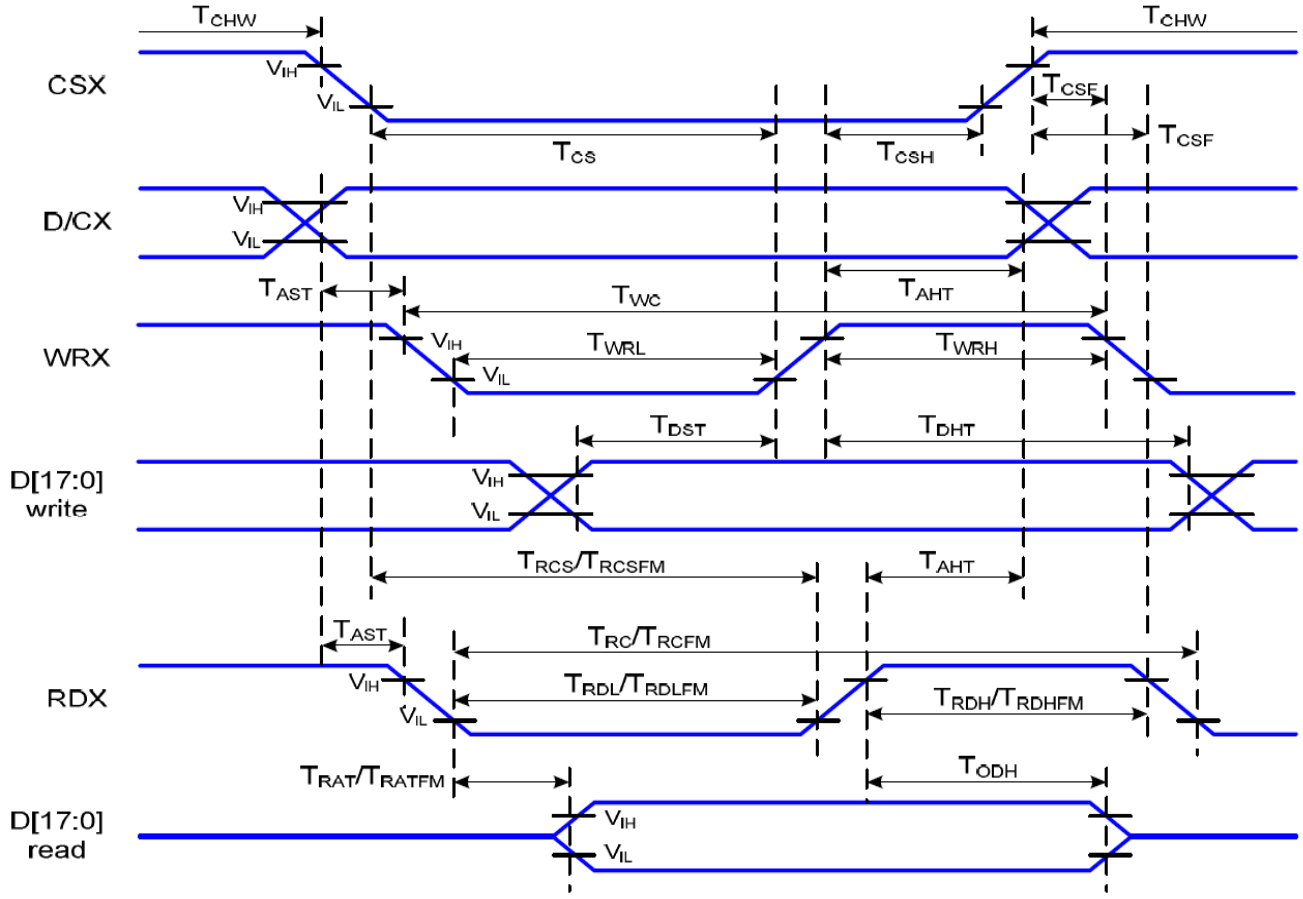


Figure6-1-1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

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

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_{RC}	Chip select setup time (Read	4		n	

	S	ID)	5		s	
	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	
DB[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_{RA}	Read access time (FM)		3	n	

	TFM			40	S	
	T_{ODH}	Output disable time	20	80	ns	

Table6-1-1 8080 Parallel Interface Characteristics

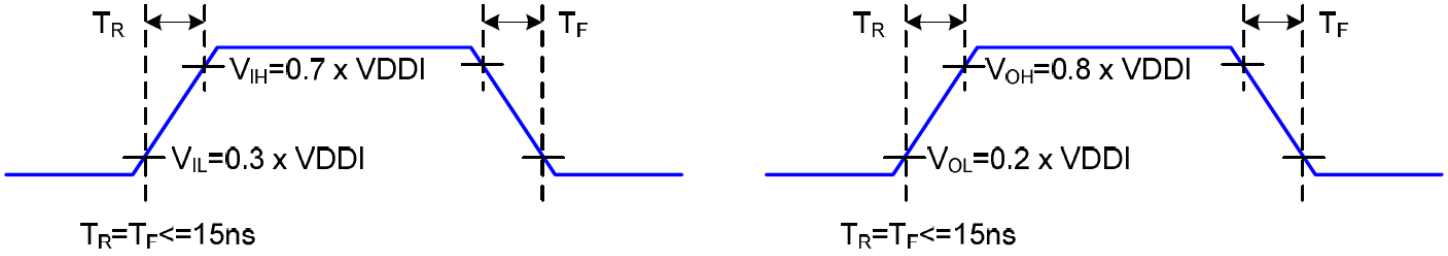


Figure6-1-2 Rising and Falling Timing for I/O Signal

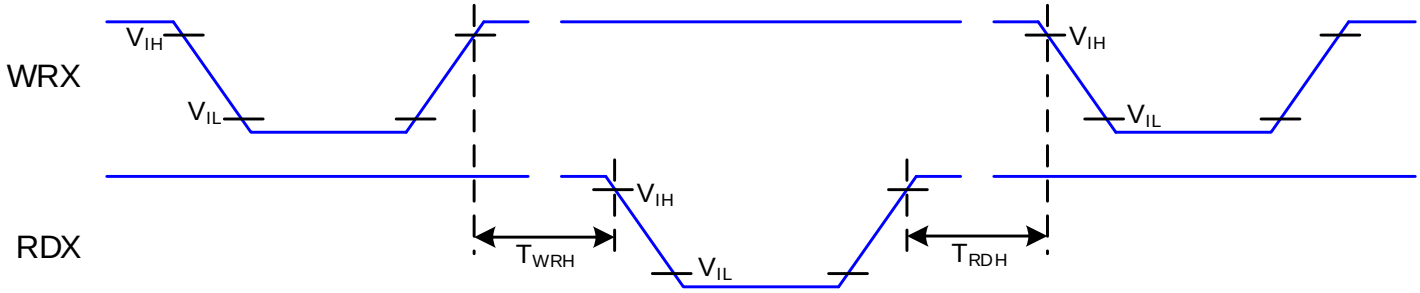


Figure6-1-3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (Tr, Tf) 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 VDDI for Input signals.

6.2 Display Serial Interface Timing Characteristics (3-line SPI system)

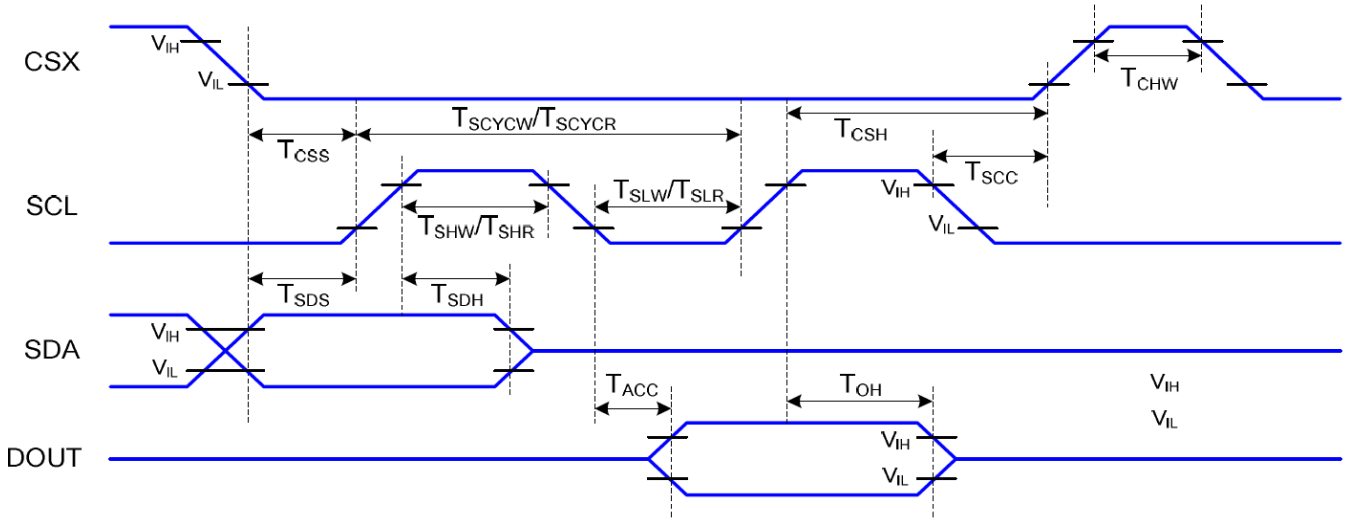


Figure6-2-1 3-line serial Interface Timing Characteristics

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

Si	Sy	Parameter	M	M	U	Description
CSX	T_C	Chip select setup time	1		n	
	T_C	Chip select hold time (write)	1		n	
	T_C	Chip select setup time	6		n	
	T_S	Chip select hold time (read)	6		n	
	T_C	Chip select “H” pulse width	4		n	
SCL	T_S	Serial clock cycle (Write)	6		n	
	T_S	SCL “H” pulse width (Write)	1		n	
	T_{SL}	SCL “L” pulse width (Write)	1		n	
	$T_{S\ CYC}$	Serial clock cycle (Read)	15		ns	
	T_S	SCL “H” pulse width (Read)	6		n	
	T_{SL}	SCL “L” pulse width (Read)	6		n	
SDA	T_S	Data setup time	1		n	
	T_S	Data hold time	1		n	
DOUT	T_A	Access time	1	5	n	For maximum CL=30pF
	T_O	Output disable time	1	5	n	

Table6-2-1 3-line serial Interface Characteristics

Note: The rising time and falling time (T_r, T_f) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

6.3 Display Serial Interface Timing Characteristics (4-line SPI system)

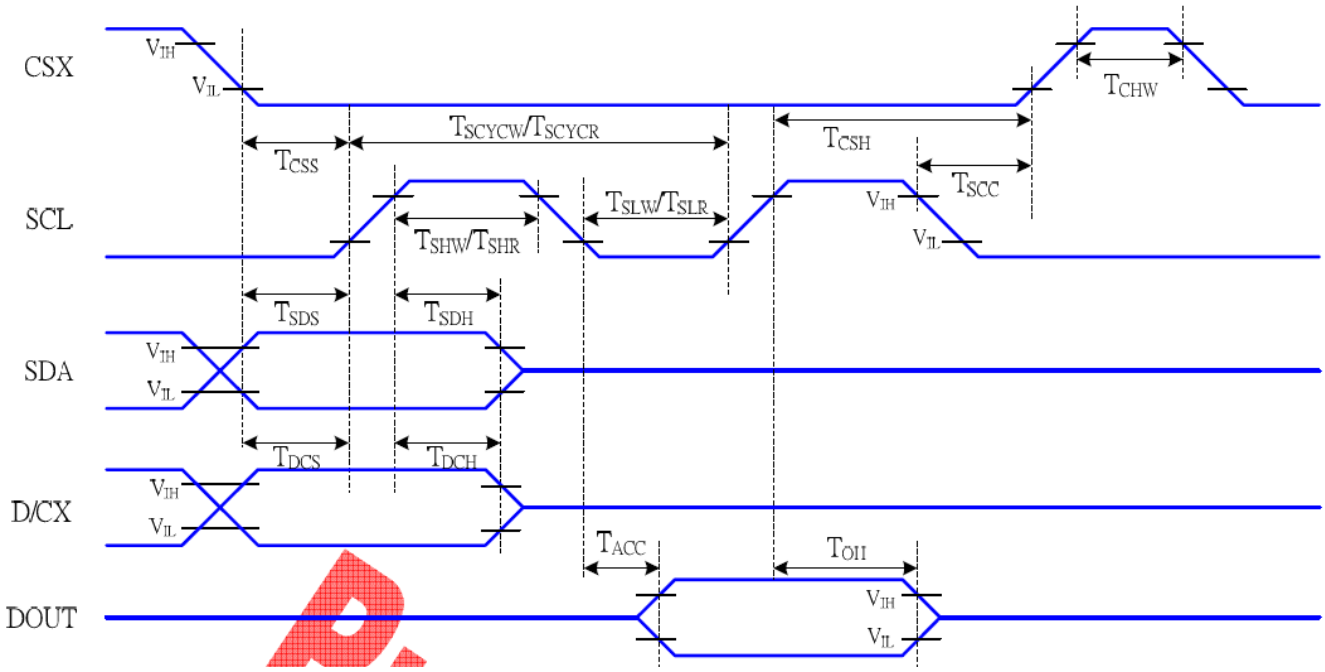


Figure6-3-1 4-line serial Interface Timing Characteristics

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

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_{DCS}	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 For minimum CL=8pF
	T_{OH}	Output disable time	15	50	ns	

Table6-2-1 4-line serial Interface Characteristics

Note: The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

6.4 Parallel RGB Interface Timing Characteristics

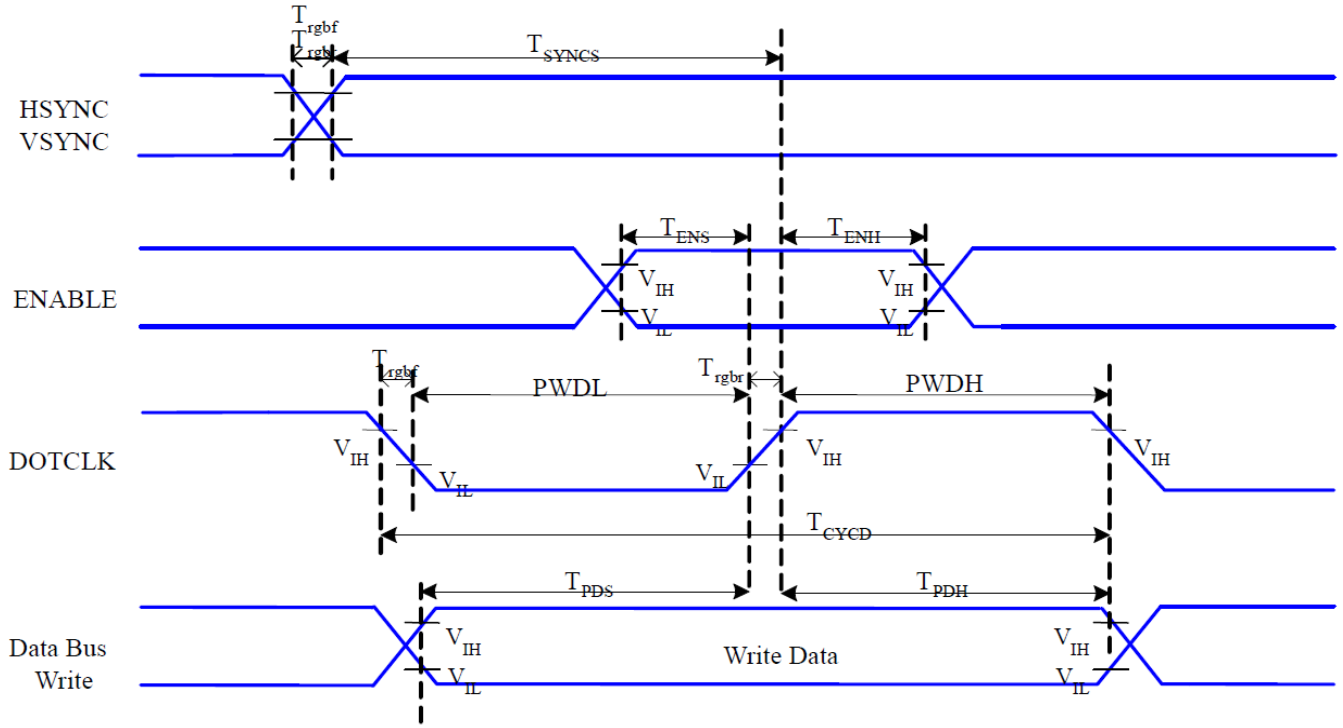


Figure6-4-1 RGB Interface Timing Characteristics

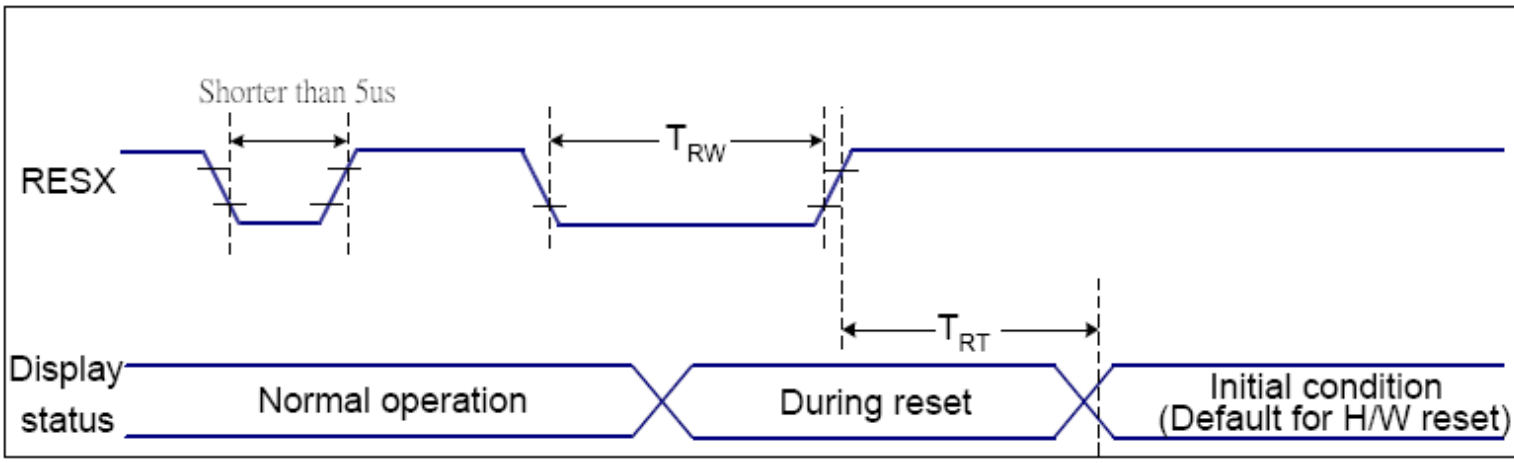
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 ℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	30		ns	
ENABLE	T_{ENS}	Enable Setup Time	25		ns	
	T_{ENH}	Enable Hold Time	25		ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60		ns	
	PWDL	DOTCLK Low-level Pulse Width	60		ns	
	T_{CYCD}	DOTCLK Cycle Time	12		ns	

			0			
	T_{rghr} T_{rghf}	DOTCLK Rise/Fall time		2 0	n s	
DB	T_{PDS}	PD Data Setup Time	5 0		n s	
	T_{PDH}	PD Data Hold Time	5 0		n s	

Table6-4-1 18/16 Bits RGB Interface Timing Characteristics

6.5 Reset Timing Characteristics



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

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

Notes:

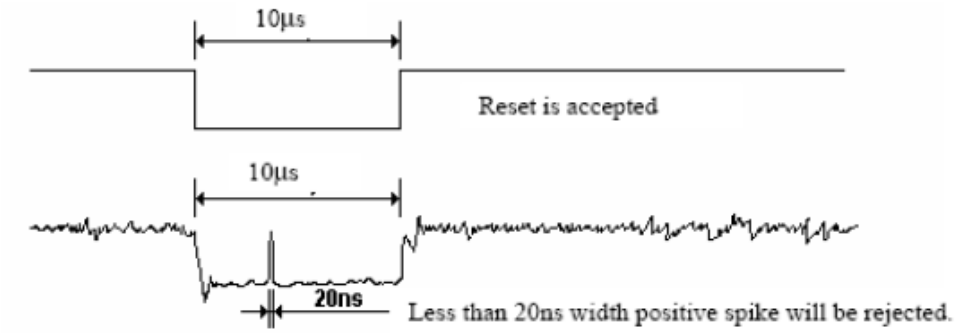
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

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.

7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

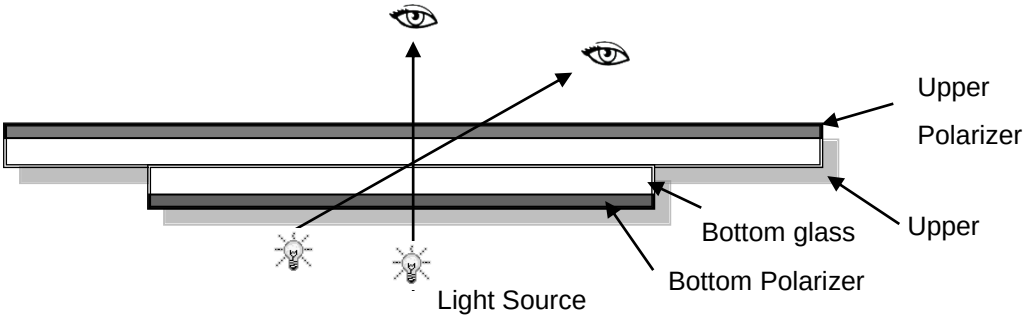
Temperature : 25±5℃

Humidity : 65%±10%RH

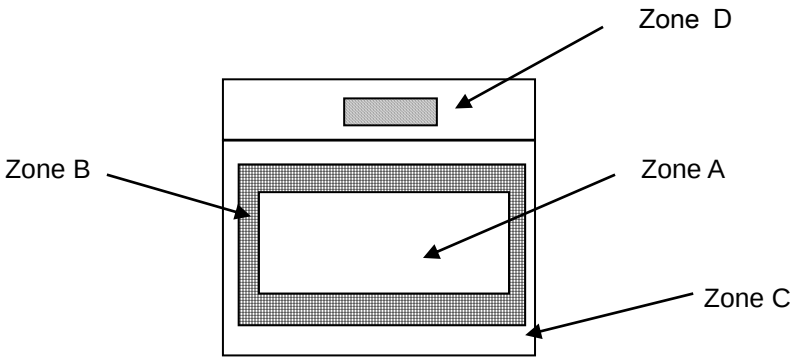
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



7.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer

Zone D : IC Bonding Area

Note:As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

7.1.3 Sampling Plan

According to GB/T 2828-2012 ; , normal inspection, Class Ⅱ

AQL:

Major defect	Minor defect
0.65	1.5

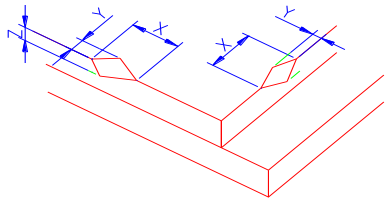
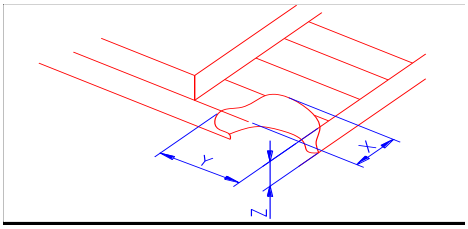
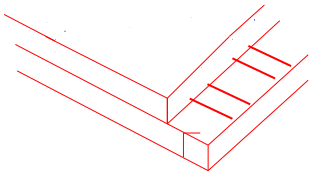
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module,

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc…	Major
2	Missing	Missing components and etc…	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed,deformation and etc…	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot,Dim spot,(Note1) Polarizer Air Bubble, Polarizer accidented spot and etc.	
6	Soldering appearance	Good soldering , Peeling off is not allowed and etc.	
7	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	

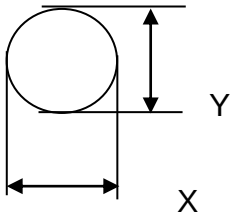
Note1: a) Light dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

7.1.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th>Criteria(mm)</th></tr>
<tr><td rowspan="3">1.0 LCD Crack/Broken
NOTE:
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>(1) The edge of LCD broken</td><td> 
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></table></td></tr>
<tr><td>(2)LCD corner broken</td><td> 
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table></td></tr>
<tr><td>(3) LCD crack</td><td> 
Crack
Not allowed</td></tr>
</table>

2.0 Spot defect



Φ=(X+Y)/2

① light dot（ black/white spot , pinhole, stain，etc.）

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.15	Ignore	Ignore	
0.15<Φ≤0.2	3(distance≧ 6		
0.25<Φ≤0.4	2 (distance≧ 6		
Φ>0.4	0		

② Dim spot（light leakage、dent、dark spot，etc）

Zone / Size (mm)	Acceptable Qty		
	A	B	C
Φ≤0.15	Ignore	Ignore	
0.15<Φ≤0.2	3(distance≧6		
0.25<Φ≤0.4	2(distance≧6		
Φ>0.4	0		

③ Polarizer accidented spot

Zone	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.5	2(distance≧6mm)		
Φ>0.5	0		

④Polarizer Bubble

Zone	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.4	3(distance≧6mm)		
Φ>0.4	0		

3.0 LCD Pixel defect

Pixel bad points

Item	Zone A	Acceptabl
Bright dot	Random	N≤2
	2 dots adjacent	N≤0
	3 dots adjacent	N≤0
Dark dot	Random	N≤2
	2 dots adjacent	N≤0
	3 dots adjacent	N≤0
Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm
Total bright and dark dot		N≤4

Note:

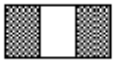
A) Bright dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

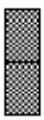
C) 2 dot adjacent = 1 pair = 2 dots

Picture:

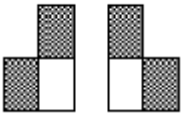
2 dot adjacent



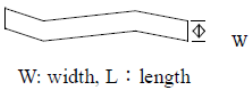
2 dot adjacent



2 dot adjacent (vertical)



2 dot adjacent (slant)

<table>
<tr>
<td>4.0</td>
<td>Line defect (LCD /Polarizer backlight black/white line, scratch, stain)
 

W: width, L：length
N：Count</td>
<td>
<table>
<tr><th rowspan="2">Width(mm)</th><th rowspan="2">Length(</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.03</td><td>Igno</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03<W≤0.04</td><td>L≤3.</td><td colspan="2">N≤2</td></tr>
<tr><td>0.04<W≤0.05</td><td>L≤2.</td><td colspan="2">N≤1</td></tr>
<tr><td>W>0.05</td><td colspan="4">Define as spot defect</td></tr>
</table>
</td>
</tr>
<tr>
<td>5.0</td>
<td>Electronic Components SMT.</td>
<td>Not allow missing parts，solderless connection，cold solder joint，mismatch，The positive and negative polarity opposite</td>
</tr>
<tr>
<td>6.0</td>
<td>Display color& Brightness.</td>
<td>1. Color：Measuring the color coordinates, The measurement standard according to the datasheet or samples.
2. Brightness：Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.</td>
</tr>
<tr>
<td>7.0</td>
<td>LCD Mura/Wavi ng/ Hot spot</td>
<td>Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.</td>
</tr>
</table>

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed

8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature	70°C,96H	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Non-display; 3.Missing segments/line; 4.Glass crack; 5.Current IDD is twice higher than initial value.
Low Temperature	-20°C, 96HRS	
High Temperature Storage	80°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Operating	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10°C,30 min ↔ +60°C,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±8KV, 5times; Contact:±6KV, 5 times; (Environment: 15℃~35℃, 30%~60%).	
Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package	
Box Drop Test	1 Corner 3 Edges 6 faces,80㎝(MEDIUM BOX)	

Remark:

1.The test samples should be applied to only one test item.

2.Sample size for each test item is 5~10pcs.

3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.

4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

5.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

6. The color fading mura of polarizing filter should not care.

9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

(1) When the module is assembled, it should be attached to the system firmly.
Do not warp or twist the module during assembly work.
(2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
(3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
(4) Do not allow drops of water or chemicals to remain on the display surface.
If you have the droplets for a long time, staining and discoloration may occur.
(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
(8) Protect the module from static; it may cause damage to the CMOS ICs.
(9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
(10) Do not disassemble the module.
(11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
(12) Pins of I/F connector shall not be touched directly with bare hands.
(13) Do not connect, disconnect the module in the “Power ON” condition.

9.2 Storage and Transportation.

(1) Do not leave the panel in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 ℃ and relative humidity of less than 70%
(2) Do not store the TFT-LCD module in direct sunlight.
(3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
(4) It is recommended that the modules should be stored under a condition where no condensation is allowed.
Formation of dewdrops may cause an abnormal operation or a failure of the module.
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
(5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.