DMT024QVNXCMI-1B
PRODUCT SPECIFICATION

Version 0.1
Jun 16, 2026

Customer's Approval	
Signature	***Date***

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Approved by *Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Jun 16, 2026	Preliminary	Yvette Hsieh

Legal Notice

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1. General Description

1.1 Introduction

This is a 2.4” size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transflective, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 240 x 320 and can display up to 262K colours. The display module supports 8/9/16/18-bit MCU, 3/4 SPI + 16/18-bit RGB Interface and 3-line/4-line Serial interface and tape bonding touch panel.

1.2 Main Features

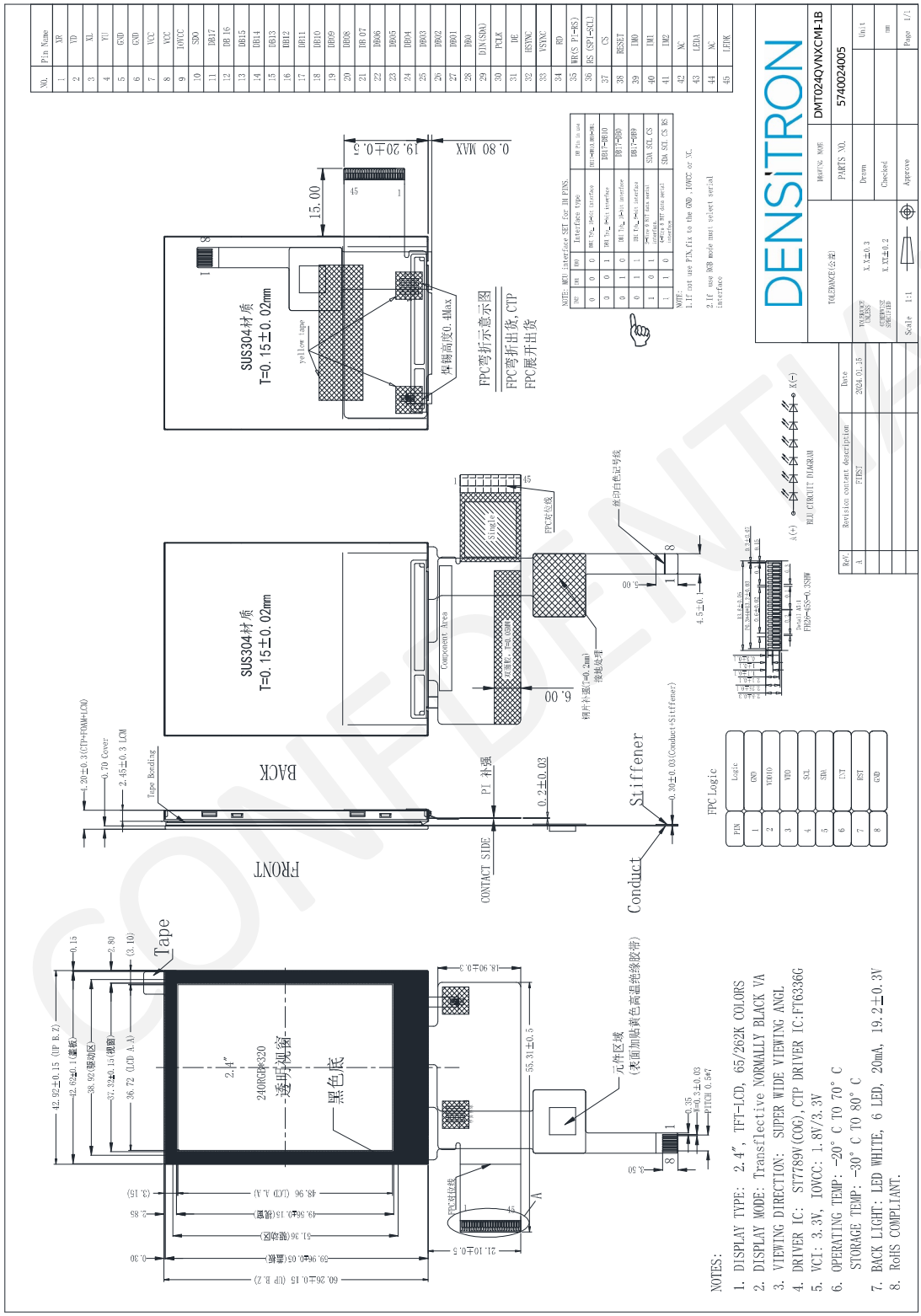
Item	Contents
Display Type	TFT LCD
Screen Size	2.4” Diagonal
Display Format	240 x RGB x 320 Dots
No. of Colour	65K/262K
Overall Dimensions	42.92 (W) x 60.26 (H) x 4.20 (D) mm
Active Area	36.72 (W) x 48.96 (H) mm
Mode	Normally Black / Transflective / VA
Surface Treatment	Glare (6H)
Viewing Direction	All round
Interface	8/9/16/18-bit MCU 3/4-SPI+16/18-bit RGB Interface 3-line/4-line Serial
Driver IC	ST7789V
Backlight Type	LED, Whites, 6 chips
Touch Panel	CTP
Touch Interface	I^2C
Touch Driver IC	FT6336G
Bonding Type	Tape Bonding
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	RoHS Compliance

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	240 x RGB x 320	Dots
Overall Dimensions	42.92 (W) x 60.26 (H) x 4.20 (D)	mm
Active Area	36.72 (W) x 48.96 (H)	mm
Dot Pitch	0.153 (W) x 0.153 (H)	mm
Weight	TBD	g
IC Controller/Driver	ST7789V	

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

(Ta=25°C, VSS=0V)

Item	Symbol	Min	Max	Unit
Digital Supply Voltage	V_{CC}	-0.3	4.6	V
Supply Voltage (Logic)	I_{OVCC}	-0.3	4.6	V
Operating Temperature	T_{OP}	-20	+70	°C
Storage Temperature	T_{ST}	-30	+80	°C

Note 1: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. For normal operations, it is desirable to use this module under the conditions according to Section 3.2 “Electrical Characteristics”, to avoid malfunctioning.

Note 2: Please refer to item of RELIABILITY.

3.2 Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Digital Supply Voltage	V_{CC}	2.4	3.3	3.6	V
Supply Voltage (Logic)	I_{OVCC}	1.65	1.8	3.3	V
Normal Mode Current Consumption	I_{DD}	-	7.3	-	mA
Level Input Voltage	V_{IH}	0.7 I_{OVCC}	-	I_{OVCC}	V
	V_{IL}	GND	-	0.3 I_{OVCC}	
Level Output Voltage	V_{OH}	0.8 I_{OVCC}	-	I_{OVCC}	V
	V_{OL}	GND	-	0.2 I_{OVCC}	

3.3 Interface Pin Assignment

3.3.1 TFT Pin Define

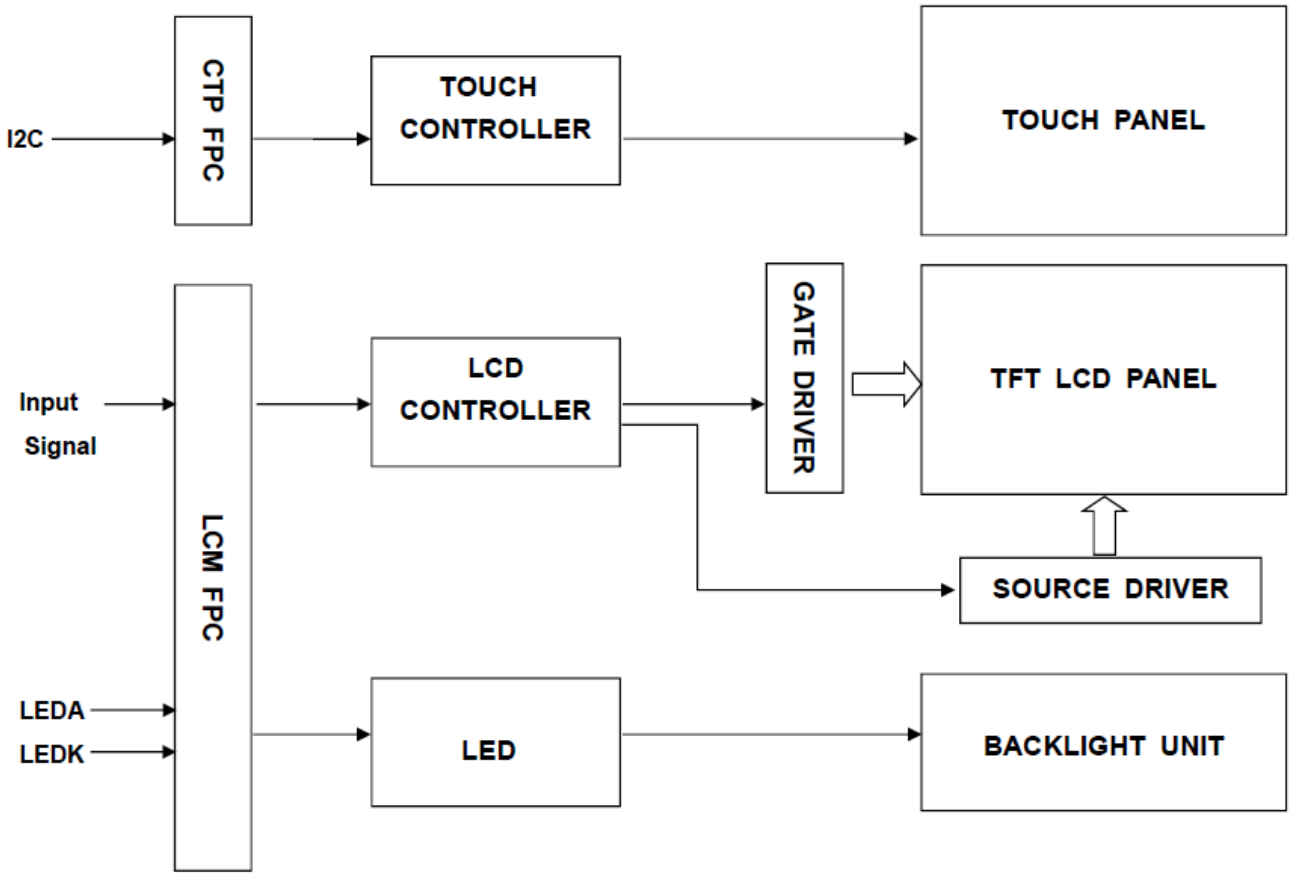
No.	Symbol	I/O	Description
1	XR	A/D	Touch panel Right Glass Terminal
2	YD	A/D	Touch panel Bottom Film Terminal
3	XL	A/D	Touch panel Left Glass Terminal
4	YU	A/D	Touch panel Top Film Terminal
5-6	GND	P	Ground
7-8	VCC	I	Supply voltage(3.3V)
9	IOVCC	I	Power Supply for I/O System
10	SDO	O	SPI interface output pin. The data is output on the falling edge of the SCL signal. If not used, let this pin open.
11-28	DB17-DB0	I/O	18-bit parallel bi-directional data bus for MCU system and RGB interface mode Fix to GND level when not in use
29	DIN (SDA)	I/O	Serial input signal. The data is latched on the rising edge of the SCL signal. fix this pin at IOVCC or GND when not in use
30	PCLK	I	Dot clock signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use
31	DE	I	Data enable signal for RGB interface operation. fix this pin at IOVCC or GND when not in use
32	HSYNC	I	Line synchronizing signal for RGB interface operation. fix this pin at IOVCC or GND when not in use
33	VSYNC	I	Frame synchronizing signal for RGB interface operation. fix this pin at IOVCC or GND when not in use
34	RD	I	Read enable in 8080 MCU parallel interface. If not used, please fix this pin at IOVCC or DGND
35	WR (SPI-RS)	I	Write enable in MCU parallel interface. Display data/command selection pin in 4-line serial interface
36	RS (SPI-SCL)	I	Display data/command selection pin in parallel interface. This pin is used to be serial interface clock. RS='1': display data or parameter. RS='0': command data.

No.	Symbol	I/O	Description
			-If not used, please fix this pin at IOVCC or DGND
37	CS	I	Chip select input pin (“Low” enable). fix this pin at IOVCC or GND when not in use
38	RESRT	I	This signal will reset the device and must be applied to properly initialize the chip
39-41	IM0-IM2	I	18-bit parallel bi-directional data bus for MCU system and RGB interface mode. Fix to GND level when not in use
42	NC	-	No connection
43	LEDA	P	Anode pin of backlight
44	NC	-	No connection
45	LEDK	P	Cathode pin of backlight

3.3.2 PCT Pin Define

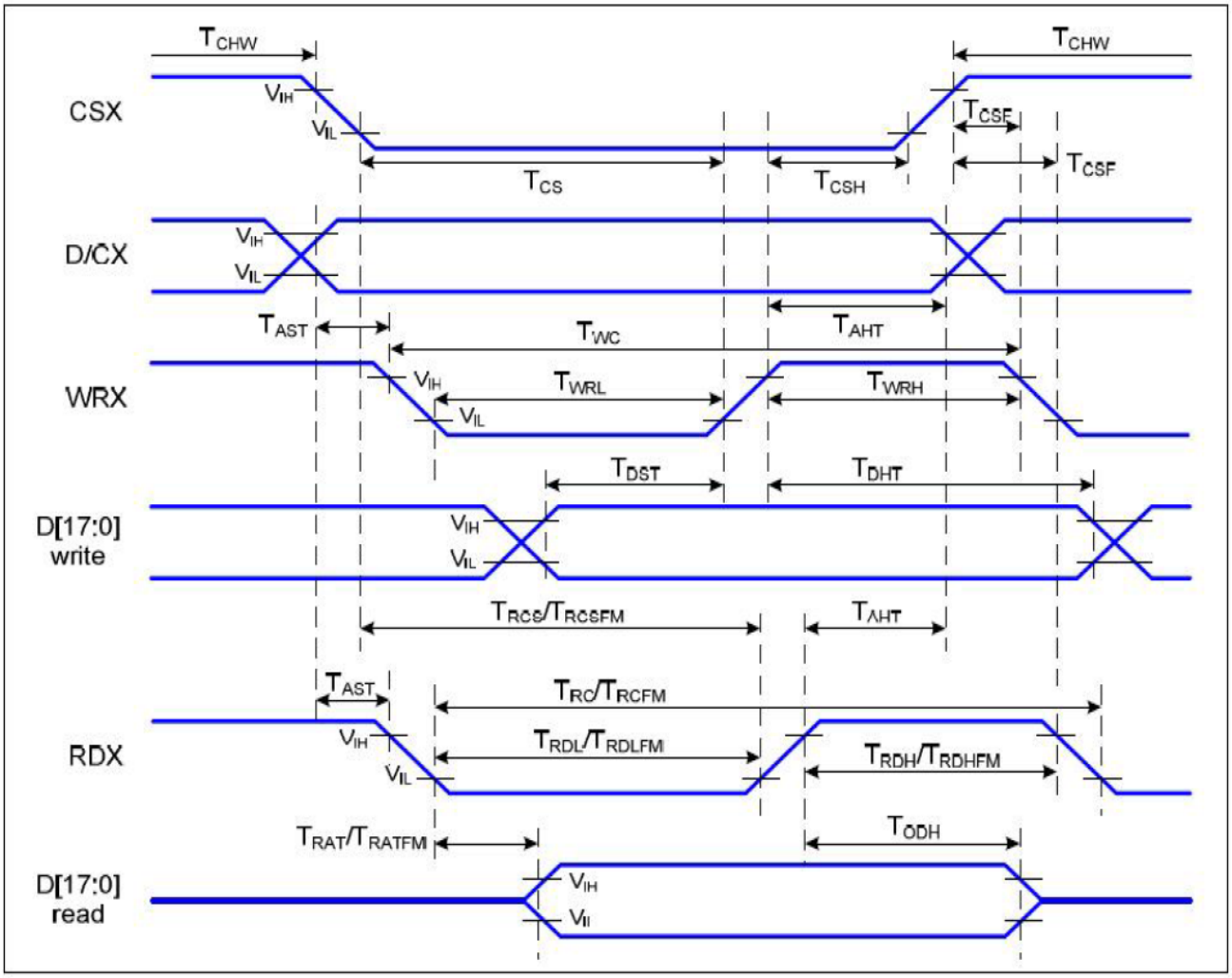
No.	Symbol	I/O	Description
1	GND	P	Ground
2	VDDIO	P	I/O power supply voltage
3	VDD	P	Supply voltage
4	SCL	I	I2C clock input
5	SDA	I/O	I2C data input and output
6	INT	I	External interrupt to the host
7	RST	I	External Reset, Low is active
8	GND	P	Ground

3.4 Block Diagram



3.5 Timing Characteristics

3.5.1 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080 system

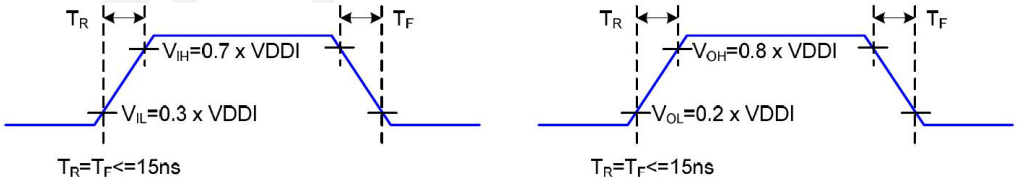


(VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C)

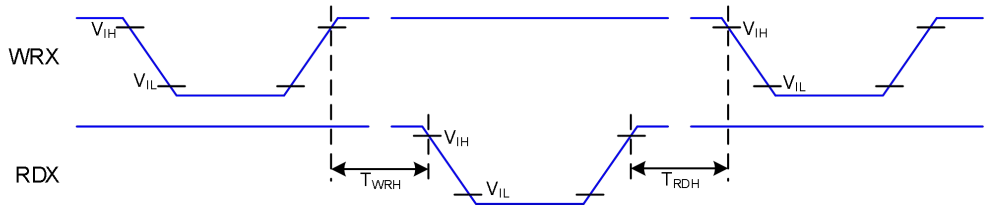
Signal	Symbol	Parameter	Min	Max	Unit	Conditions
D/CX	T_{AST}	Address setup time	0	-	ns	-
	T_{AHT}	Address hold time (Write/Read)	10	-	ns	-
CSX	T_{CHW}	Chip select H pulse width	0	-	ns	-
	T_{CS}	Chip select setup time (Write)	15	-	ns	-
	T_{RCS}	Chip select setup time (Read ID)	45	-	ns	-

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
	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 “H” duration (FM)	90	-	ns	
	T_{RDLFM}	Control “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_{RATFM}	Read access time (FM)	-	340	ns	
	T_{ODH}	Output disable time	20	80	ns	

Rising and Falling Timing for I/O Signal

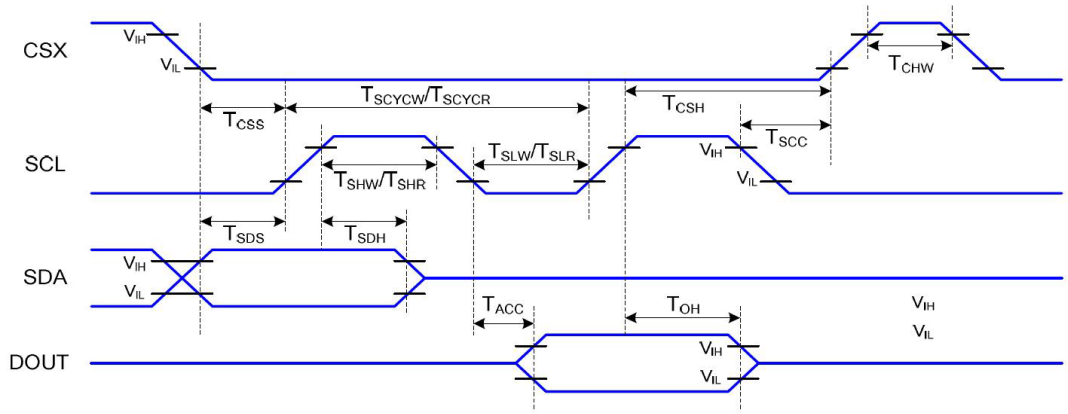


Write-to-Read and Read-to-Write Timing



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.

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

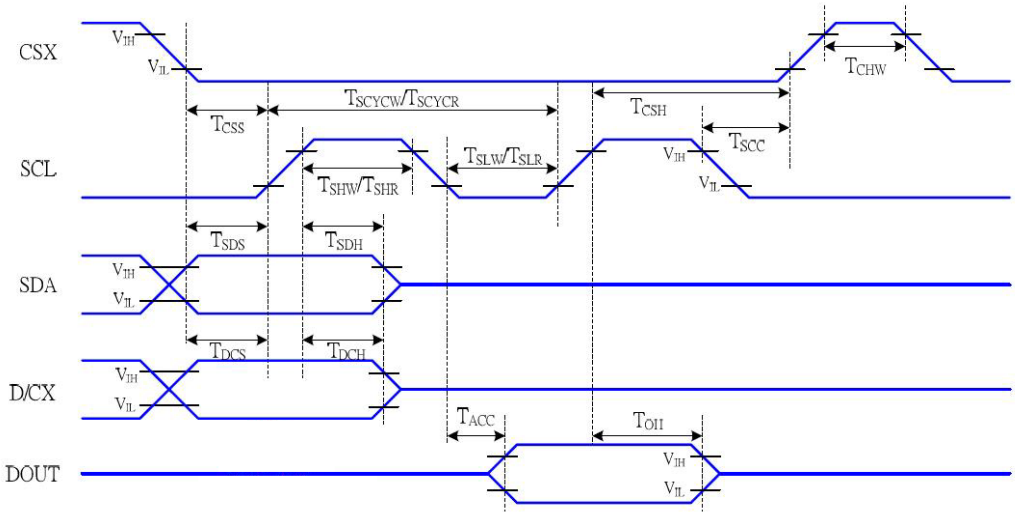


(VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= 25°C)

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
CSX	T_{SCC}	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	-
	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	-
	T_{SHR}	SCL “H” pulse width (read)	60	-	ns	-
	T_{SLR}	SCL “L” pulse width (read)	60	-	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

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.

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



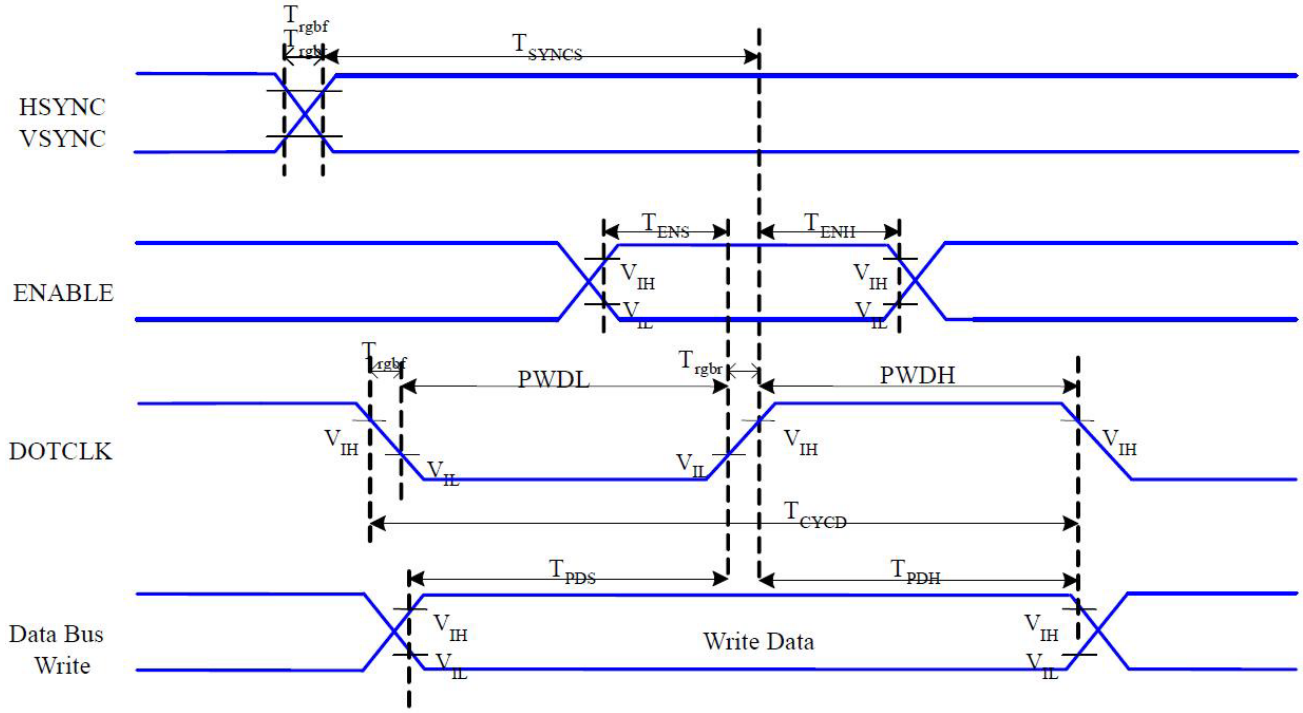
(VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= 25°C)

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
CSX	T_{CSS}	Chip select 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	
	TS_{CYCR}	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	-

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL = 30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL = 8pF

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.

3.5.4 Parallel RGB Interface Timing Characteristics

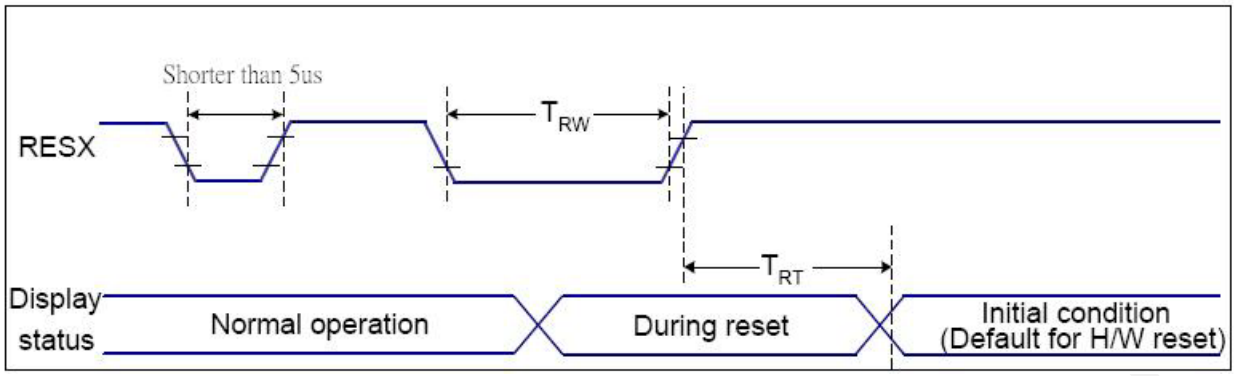


(VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C)

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
VSYNC/HSYNC	T_{SYNCS}	VSYNC/HSYNC setup time	30	-	ns	18/16-bit RGB
ENABLE	T_{ENS}	Enable setup time	25	-	ns	
	T_{ENH}	Enable hold time	25	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	60	-	ns	
	PWDL	DOTCLK low-level period	60	-	ns	
	T_{CYCD}	DOTCLK cycle time	120	-	ns	
	T_{rghr}, T_{rghf}	DOTCLK rise/fall time	-	20	ns	
DB	T_{PDS}	PD data setup time	50	-	ns	
	T_{PDH}	PD data hold time	50	-	ns	
VSYNC/HSYNC	T_{SYNCS}	VSYNC/HSYNC setup time	25	-	ns	8/6-bit RGB
ENABLE	T_{ENS}	Enable setup time	25	-	ns	

Signal	Symbol	Parameter	Min	Max	Unit	Conditions
	T_{ENH}	Enable hold time	25	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	25	-	ns	
	PWDL	DOTCLK low-level period	25	-	ns	
	T_{CYCD}	DOTCLK cycle time	55	-	ns	
	T_{rghr}, T_{rghf}	DOTCLK rise/fall time	-	10	ns	
DB	T_{PDS}	PD data setup time	25	-	ns	
	T_{PDH}	PD data hold time	25	-	ns	

3.5.5 Reset Timing Characteristics



Related Pins	Symbol	Parameter	Min	Max	Unit	Note
RESX	tRW	Reset pulse duration	10	-	us	-
	tRT	Reset cancel	-	5	ms	1, 5
			-	120	ms	1, 6, 7

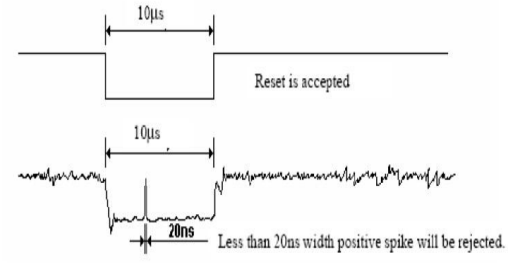
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other setting NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note 2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shote than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset Starts

Note 3: During the Resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, 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.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below.



Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

Mote 7: It is necessary to wait 5 ms after releasing RESX before sending commands. Also Sleep Out Command cannot ne sent for 120 ms.

4. Electrical Specification Touch

4.1 Electrical Characteristics

4.1.1 Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit
Power Supply Voltage	VDD	-0.3	3.6	V
I/O Digital Voltage	VDDIO	1.8	3.6	V
Operating Temperature	T_{OP}	-20	+70	°C
Storage Temperature	T_{ST}	-30	+80	°C

4.1.2 DC Electrical Characteristics

(Ta=25°C)

Item	Symbol	Condition	Min	Typ.	Max	Unit
Power Supply Voltage	VDD	-	2.8	3.3	3.6	V
I/O Digital Supply Voltage	VDDIO	-	1.8	3.3	3.6	V
Normal mode operating current	I_{opr}	VDD=2.8V, Ta=25°C, MCLK=17.5Mhz	-	4	-	mA
Monitor mode operating current	I_{mon}		-	1.5	-	mA
Sleep mode operating current	I_{slp}		-	50	-	uA
Level Input voltage	V_{IL}	-	-0.3	-	0.3 V_{DDIO}	V
	V_{IH}	-	0.7 V_{DDIO}	-	V_{DDIO}	V
Level Output voltage	V_{OL}	I_{OH} = 0.1mA	-	-	0.3 V_{DDIO}	V
	V_{OH}	I_{OH} = -0.1mA	0.7 V_{DDIO}	-	-	V

4.2 AC Electrical Characteristics

AC Characteristics of Oscillators

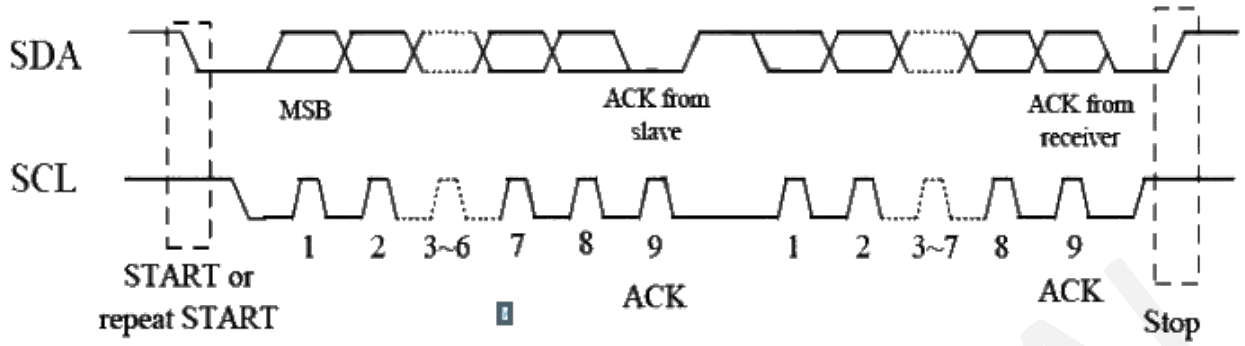
Item	Symbol	Unit	Test Condition	Min	Typ	Max
OSC Clock 1	fosc	MHz	VDDA = 2.8V, Ta = 25°C	34.65	35.00	35.35

AC Characteristics of Sensor

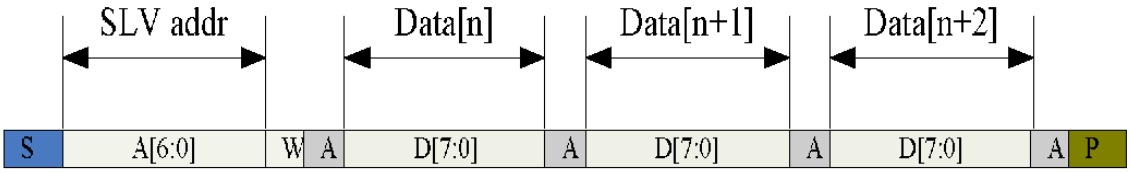
Item	Symbol	Unit	Test Condition	Min	Typ	Max
Sensor Acceptable Clock	ftx	KHz	VDDA = 2.8V, Ta = 25°C	0	100	300
Sensor Output Rise Time	Ttxr	ns		-	100	-
Sensor Output Fall Time	Ttxf	ns		-	80	-
Sensor Input Voltage	Trxi	V		-	5	-

4.3 I²C Timing

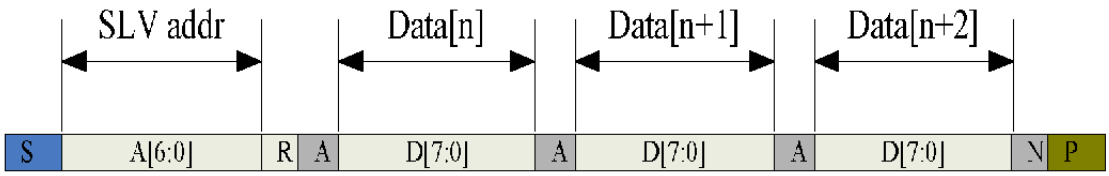
The I2C is always configured in the Slave mode. The data transfer format is shown below.



I²C Master Write, Slave Read



I2C Master Read, Slave Write



Mnemonics Description

Mnemonics	Description
S	I2C Start or I2C Restart
A [6:0]	Slave Address
R/W	Read/Write bit, '1' for read, '0' for write
A(N)	ACK (NACK) bit
P	**STOP:** the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

I2C Interface Timing Characteristics is shown in the below table.

I2C Timing Characteristics

Item	Min	Max	Unit
SCL Frequency	10	400	KHz
Bus free time between a STOP and START condition	4.7	-	us
Hold time (repeated) Start condition	4.0	-	us
Data setup time	250	-	ns
Setup time for a repeated Start condition	4.7	-	us
Setup Time for STOP condition	4.0	-	us

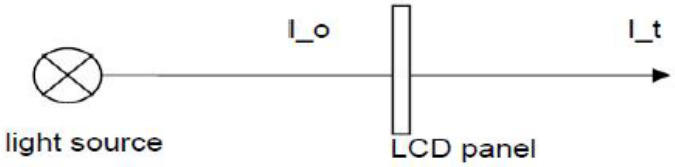
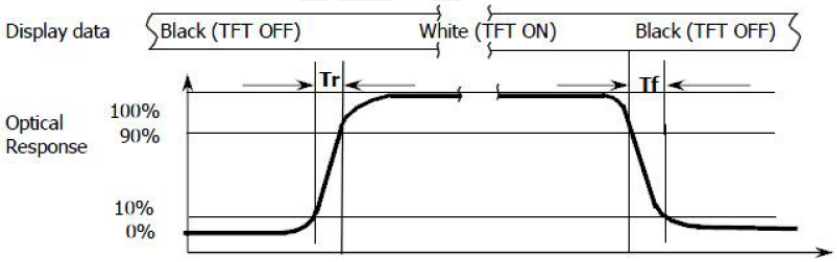
5. Optical Specification

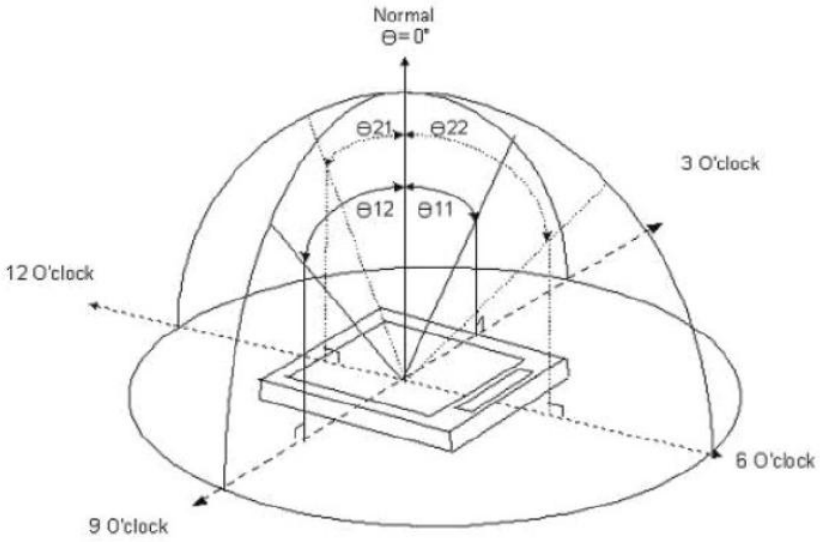
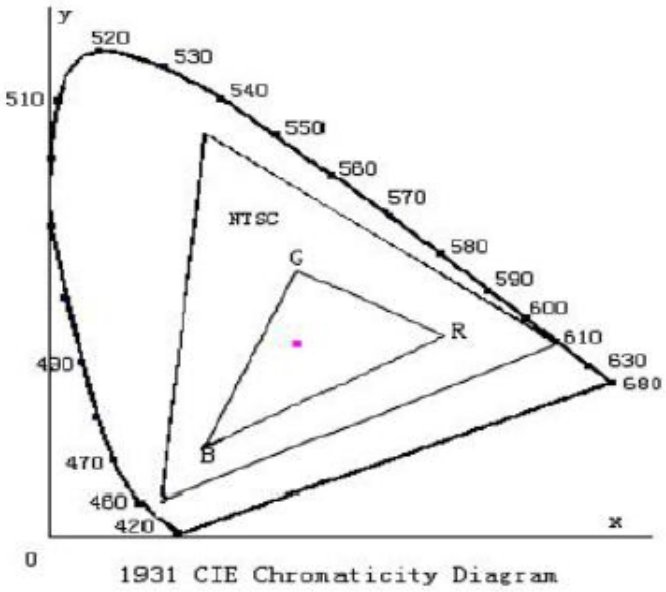
5.1 Optical Characteristics

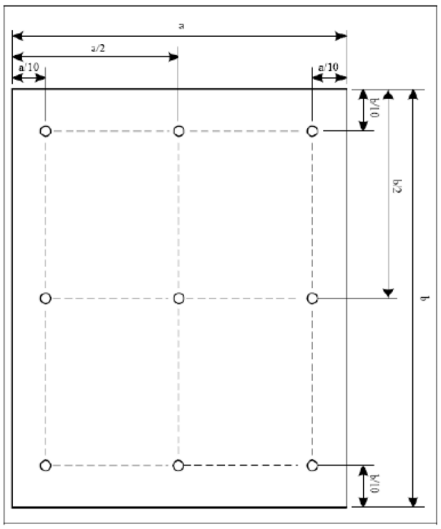
Characteristics		Symbol	Conditions	Min	Typ	Max	Unit	Note
Contrast Ratio		CR	θ = 0° Normal viewing angle	-	300	-	-	3
Response time		$T_R + T_F$		-	25	50	msec	2
Color Gamut		S (%)		-	60	-	%	5
Viewing Angle	Left	Θ11	CR>10	60	80	-	deg	4
	Right	Θ12		60	80	-		
	Up	Θ21		60	80	-		
	Down	Θ22		60	80	-		
Colour Chromaticity	Red	Rx	θ = 0° Normal viewing angle	-0.04	0.443	+0.04	-	-
		Ry			0.315			
	Green	Gx			0.310			
		Gy			0.501			
	Blue	Bx			0.172			
		By			0.127			
	White	Wx			0.281			
		Wy			0.308			
Luminance		Lv	I_F = 20mA	250	300	-	cd/m^2	6
Uniformity		Avg		80	-	-	%	6

Note: Measuring Condition = in dark room, at ambient temperature 25±2℃, for 15 min 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	Item	Test method
1	Definition of Transmittance	The transmittance of the panel including polazierts is measured with electrical driving  The transmittance is defined as: Tr = I_t/I_o x 100% I_o: the brightness of the light source I_t: the brightness after panel transmission
2	Definition of Response Time	The rise tiem “Tr” is defined as the tiem for luminance from 10% to 90% as a result of a change of the electrical condition. The fall time “Tf” is defined as the time for luminance to change from 90% to 10% as a result of a change of the elcectical condition 
3	Definition of Contrast Ration	The contrast ratio (Cr), measured on a module, is the ratio bewteen the luminance (L_w) in a full white area (R=G=B=1) and the luminance (L_d) in a dark ared (R=G=B=0) $Cr = \frac{L\_w}{L\_d}$

Note	Item	Test method
4	Definition of Viewing Angle	
5	Definition of Colour Gamut	Measuring machine: CGT-01. NTSC's Primaries: R(x, y, Y), G(x, y, Y), B (x, y, Y)  1931 CIE Chromaticity Diagram **Fig. 1931 CIE chromaticity diagram** Color gamut: $S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$

Note	Item	Test method
5	Definition of Luminance Uniformity	 $\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$ $\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$

6. LED Backlight Specification

6.1 LED Backlight Characteristics

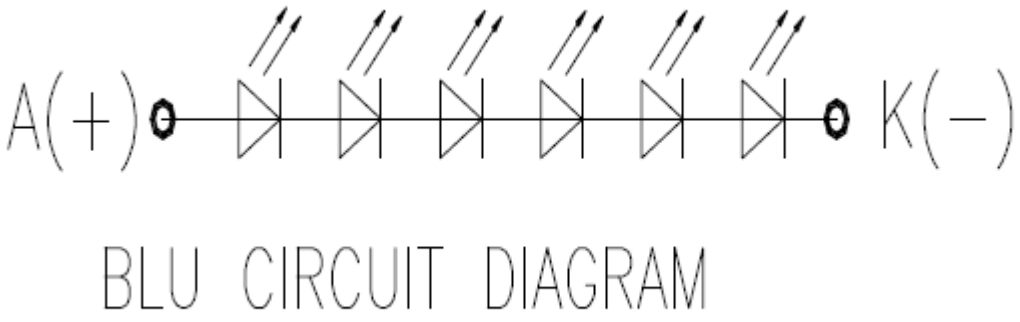
The back-light system is edge-lighting type with 6 chips White LED

Item	Symbol	Min	Typ	Max	Unit	Note
Forward Current	I_F	15	20	-	mA	-
Forward Voltage	V_F	-	19.2	-	V	-
LED Lifetime	Hr	50000	-	-	Hour	1, 2

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3°C, 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°C and IL=20mA. The LED lifetime could be decreased if operating IL is larger than 20mA. The constant current driving method is suggested.

6.2 Internal Circuit Diagram



BLU CIRCUIT DIAGRAM

7. Packaging

TBD

8. Quality Assurance Specification

8.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

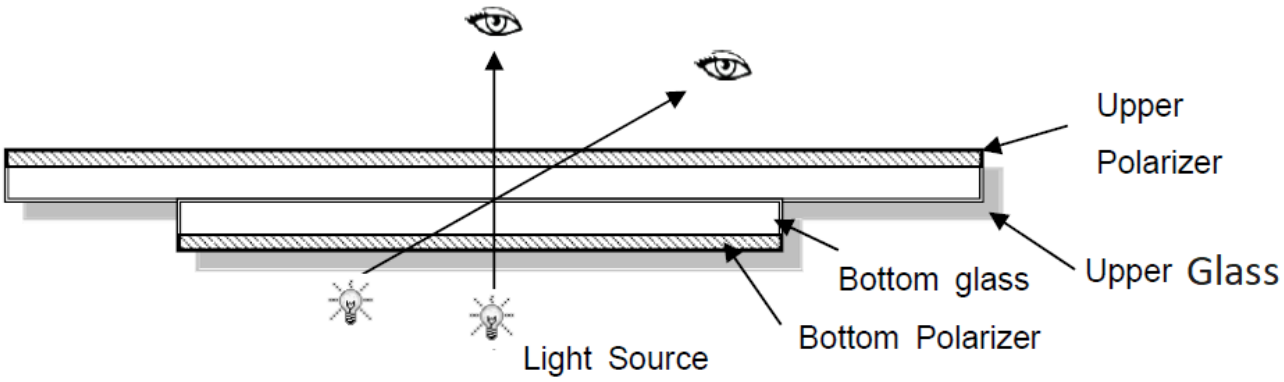
8.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:	25 ± 5°C
Humidity:	65% ± 10% RH
Viewing Angle:	Normal Viewing Angle
Illumination:	Single fluorescent lamp (300 to 700 Lux)
Viewing distance:	30 - 50cm

Finger glove (or finger cover) must be worn by the inspector.

Inspection table or jig must be anti-electrostatic.

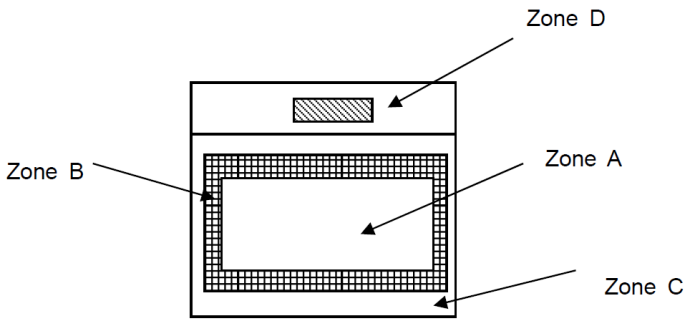


8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

Class II, Normal Inspection, ISO2859-1

8.3.2 Zone 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) Area which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

Note: Generally, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

8.3.3 Criteria & Acceptable Quality Level

Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

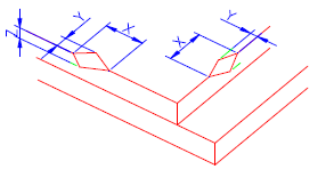
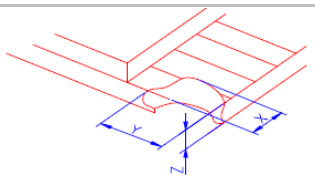
No.	Items	Criteria	Classification of defects
1	Functional defects	1) No display, open or miss line 2) Display abnormally 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component etc.	
3	Outline dimension	Overall outline dimension beyond the drawing, deformation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

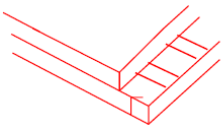
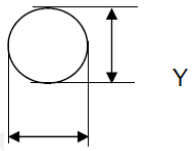
Note 1: a) Light dot：Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

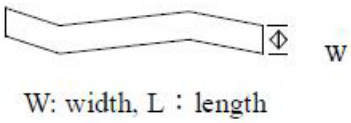
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

8.3.4 Criteria & Classification

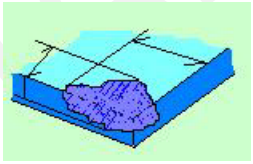
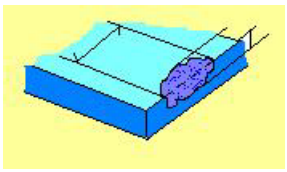
Units: mm

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td rowspan="2">1.0 LCD Crack/Broken
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>The edge of LCD broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤ 3.0</td><td>< Inner border line of the seal</td><td>≤ T</td></tr>
</table></td></tr>
<tr><td>LCD corner broken</td><td>  </td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤ 3.0</td><td>< L</td><td>≤ T</td></tr>
</table>
</td></tr>
<tr><td></td><td>LCD crack</td><td> 
Crack Not allowed</td></tr>
<tr><td>2.0</td><td>Spot defect
 
Φ=(X+Y)/2</td><td>1. light dot (black/white spot, pinhole, stain etc)
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ ≤ 0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1 < Φ ≤ 0.2</td><td colspan="2">3 (distance ≥ 10mm)</td></tr>
<tr><td>0.2 < Φ ≤ 0.25</td><td colspan="2">2</td></tr>
<tr><td>Φ > 0.3</td><td colspan="2">0</td></tr>
</table>
2. Dim spot (Dim dot, light leakage, dent, dark spot etc)
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ ≤ 0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1 < Φ ≤ 0.2</td><td colspan="2">3 (distance ≥ 10mm)</td></tr>
<tr><td>0.2 < Φ ≤ 0.25</td><td colspan="2">2</td></tr>
<tr><td>Φ > 0.3</td><td colspan="2">0</td></tr>
</table>
3. Polarizer accidented spot
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ ≤ 0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.3 < Φ ≤ 0.5</td><td colspan="2">2 (distance ≥ 10mm)</td></tr>
<tr><td>Φ>0.5</td><td colspan="2">0</td></tr>
</table>
4. Pixel bad points
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ ≤ 0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.15 < Φ ≤ 0.2</td><td colspan="2">2 (distance ≥ 10mm)</td></tr>
<tr><td>0.2 < Φ</td><td colspan="2">0</td></tr>
</table>
5. Polarizer Bubble
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Φ ≤ 0.2</td><td>Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.3 < Φ ≤ 0.4</td><td>3 (distance ≥ 10mm)</td></tr>
<tr><td>0.5 < Φ ≤ 0.6</td><td>2</td></tr>
<tr><td>0.6 < Φ</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>3.0</td><td>Line defect (LCD/ /Polarizer backlight black/white line, scratch, stain)
 

W: width, L：length</td><td>
<table>
<tr><th rowspan="2">Width</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>W ≤ 0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03 < W ≤ 0.04</td><td>L ≤ 3.0</td><td colspan="2">N ≤ 2</td></tr>
<tr><td>0.04 < W ≤ 0.05</td><td>L ≤ 2.0</td><td colspan="2">N ≤ 1</td></tr>
<tr><td>0.05 < W</td><td colspan="4">Define as spot defect</td></tr>
</table>
</td></tr>
<tr><td>4.0</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>5.0</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>6.0</td><td>LDC Mura/Waving/Hot Spot</td><td>Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary. (Θ=θ=0)</td></tr>
<tr><td rowspan="3">7.0</td><td rowspan="3">CTP Related</td><td>CTP Cover sensor accidented black/white spot</td><td>
<table>
<tr><th rowspan="2">Width (mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ ≤ 0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1 < Φ ≤ 0.2</td><td colspan="2">3 (distance ≥ 10mm)</td></tr>
<tr><td>0.20 < Φ ≤ 0.25</td><td colspan="2">2</td></tr>
<tr><td>Φ > 0.3</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>CTP Cover scratch</td><td>
<table>
<tr><th rowspan="2">Width (mm)</th><th rowspan="2">Length (mm)</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>Ignore</td><td colspan="3">Ignore</td></tr>
<tr><td>0.03 < W ≤ 0.04</td><td>L ≤ 3.0</td><td colspan="3">N ≤ 2</td></tr>
<tr><td>0.04 < W ≤ 0.05</td><td>L ≤ 2.0</td><td colspan="3">N ≤ 1</td></tr>
<tr><td>0.05 < W</td><td colspan="4">defined as spot defect</td></tr>
</table>
</td></tr>
<tr><td>CTP Cover Pinhole/Lack of ink</td><td>
<table>
<tr><th rowspan="2">Size/Zone</th><th>Acceptable Qty</th></tr>
<tr><th>C</th></tr>
<tr><td>Φ ≤ 0.1</td><td>Ignore</td></tr>
<tr><td>0.1 < Φ ≤ 0.2</td><td>3 (distance ≥ 10mm)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th colspan="2">Item</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td></td><td>0.2 < Φ ≤ 0.25</td><td>2</td></tr>
<tr><td></td><td>Φ > 0.3</td><td>0</td></tr>
<tr><td>CTP Bonding bubble/ accidented spot</td><td colspan="2"><table><tr><th rowspan="2">Size (mm)</th><th colspan="2">Acceptable Qty</th></tr><tr><th>A</th><th>B</th></tr><tr><td>Φ ≤ 0.1</td><td colspan="2">Ignore</td></tr><tr><td>0.1 < Φ ≤ 0.15</td><td colspan="2">2 (distance ≥ 10mm)</td></tr><tr><td>0.15 < Φ ≤ 0.2</td><td colspan="2">1</td></tr><tr><td>Φ > 0.2</td><td colspan="2">0</td></tr></table></td></tr>
<tr><td>Assembly deflection</td><td colspan="2">beyond the edge of backlight ≤ 0.2mm</td></tr>
<tr><td>CTP cover broken
X：length
Y：width
Z：height</td><td colspan="2"><table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>X ≤ 0.5mm</td><td>Y ≤ 0.5mm</td><td>Z < cover thickness</td></tr></table>Circuitry broken is not allowed
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>X ≤ 0.3mm</td><td>Y ≤ 0.3mm</td><td>Z < cover thickness</td></tr></table></td><td> 
  </td></tr>
</table>

Criteria (functional item)

No	Item	Criteria
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	CTP no function	Not allowed

8.4 Dealing with Customer Complaints

8.4.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in reasonable time and update the status to the purchaser.

8.4.2 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

9. Reliability Specification

9.1 Reliability Tests

Test Item	Test Condition	Inspection after test
High Temperature Operation	70°C, 96 hours	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 Operation	-20°C, 96 hours	
High Temperature Storage	80°C, 96 hours	
Low Temperature Storage	-30°C, 96 hours	
High Temperature & High Humidity Storage	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-30°C, 30 min ↔ +80°C, 30 min, Change time: 5min 20CYC.	
ESD test	C=150pF, R=330, 5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times. (Environment: 15°C ~35°C, 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 condition).	
Box Drop Test	1 Corner 3 Edges 6 faces, 80cm (MEDIUM BOX)	

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

Note 2: Sample size for each test item is 5~10 pieces.

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

Note 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.

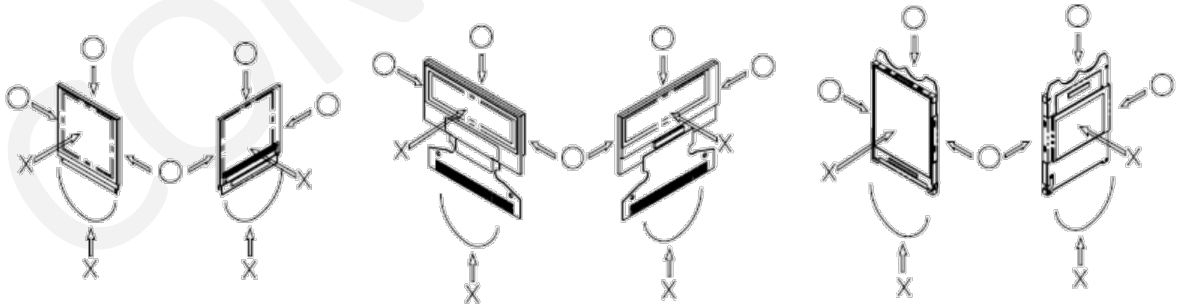
Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

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

10. Handling Precautions

10.1 Handling Precautions

1) Since the display panel is made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   a. Scotch Mending Tape No. 810 or an equivalent
   b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
      - Water
      - Ketone
      - Aromatic Solvents
7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.
8) Do not apply stress to the LSI chips and the surrounding molded sections.
9) Do not disassemble nor modify the display module.
10) Do not apply input signals while the logic power is off.
11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.
    a. Be sure to make human body grounding when handling display modules.

b. Be sure to ground tools to use or assembly such as soldering irons.
c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.

12) A Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

10.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you store these modules in the packaged state when they are shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

10.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the display module, fasten the external plastic housing section.
7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

10.4 Operation Precautions

1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
3) Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
   a. Pins and electrodes
   b. Pattern layouts such as the FPC
5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
   a. Design the product and installation method so that the driver may be shielded from light in actual usage.
   b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from the influences of noise on the system design.
7) We recommend you construct its software to make periodical refreshments of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

10.5 Cleaning Precautions

1) Keep TFT Scratch free: Avoid using abrasive materials like paper towels and newspaper in cleaning TFT LCD screens as they may scratch the surface. Instead, opt for a lint-free cloth. Don't spray the liquid directly on the monitor and remember to put gentle pressure when wiping the screen.

2) Avoid Vibration: During cleaning process, try to keep the TFT on shock proof platform to avoid strong shock and vibration. Do not apply pressure to the LCD screen of the LCD or bump or squeeze the LCD display back cover.

3) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of using the following adhesion tape:

a) Scotch Mending Tape No. 810 or an equivalent.

b) Never try to breathe upon the soiled surface.

c) List of Safe and Unsafe solvents to clean TFT display:

Safe Solvents	Unsafe Solvents
Distilled Water	Ammonia
Isopropyl Alcohol	Acetone
Diluted White Vinegar = Water (Mix 1 part vinegar + 5 parts of Water)	Ethyl Alcohol
	Methyl Chloride
	Ethyl Acid

10.6 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.