TFT Module Specification

MODEL: 13-028QFCB0HB0-S

< ◇ > PRELIMINARY SPECIFICATION
< ◆ > APPROVAL SPECIFICATION

CUSTOMER
APPROVED BY
DATE:

DESIGNED	CHECKED	APPROVED
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RECORD OF REVISION

Version	Revised Date	Page	Content
V1.0	2026/03/16	--	First specification.

TABLE OF CONTENTS

No.	Content	Page
	TFT Module Specification	1
	TABLE OF CONTENTS	3
1.	GENERAL DESCRIPTION	4
2.	MECHANICAL SPECIFICATION	5
3.	PIN DESCRIPTION	6
4.	ABSOLUTE MAXIMUM RATINGS	9
5.	BLOCK DIAGRAM	10
6.	ELECTRICAL CHARACTERISTICS	11
7.	AC CHARACTERISTICS	12
8.	OPTICAL CHARACTERISTICS	18
9.	RELIABILITY	23
10.	PRECAUTION RELATING PRODUCT HANDLING	28

1. GENERAL DESCRIPTION

1.1 Description

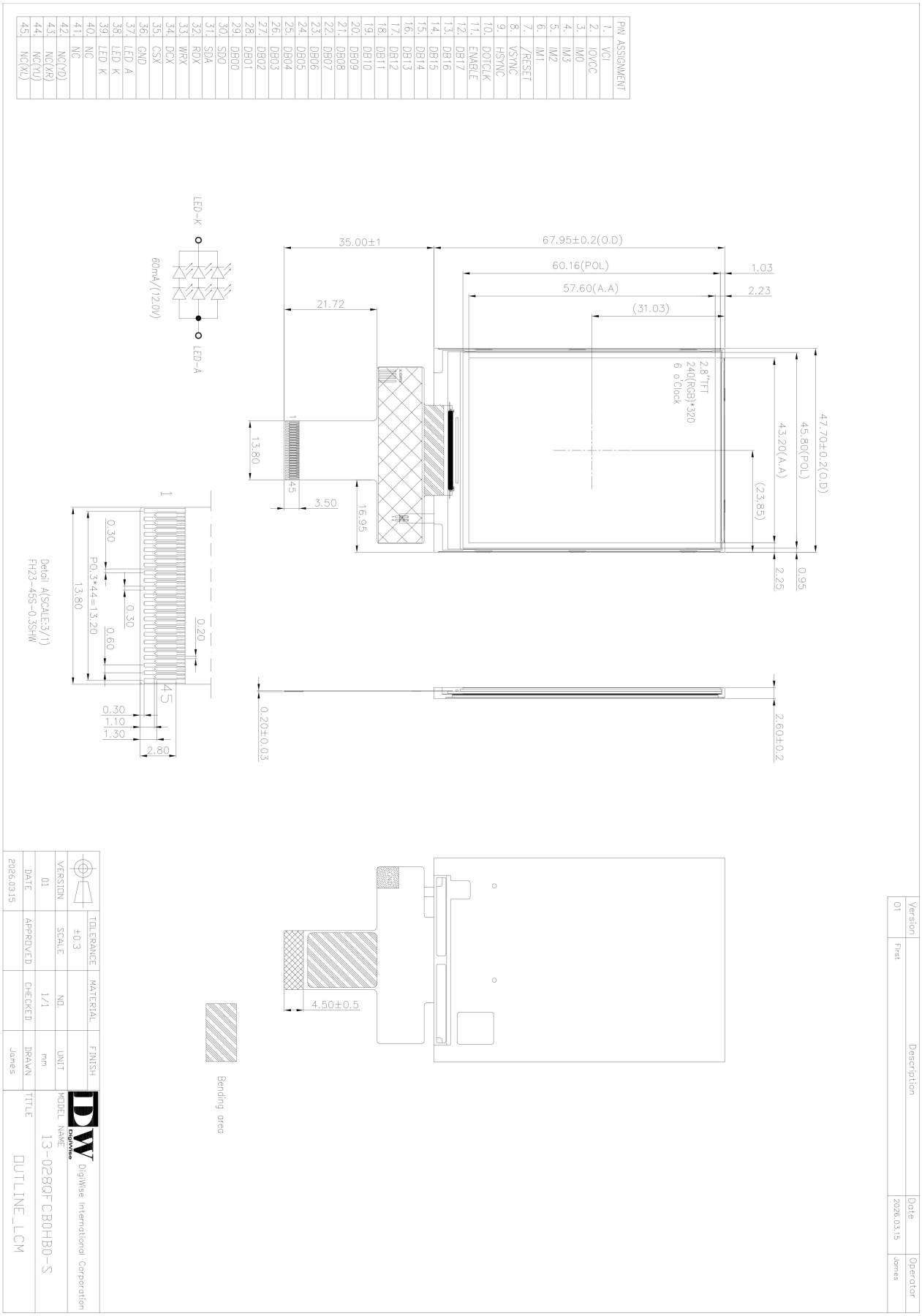
The specification is model 13-028QFCB0HB0-S is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a transflective type TFT panel, a driving circuit, and a backlight system. This TFT LCD has a 2.8 inch diagonally measured active display area with QVGA (240 horizontal by 320 vertical pixels) resolution.

1.2 Features:

No.	Item	Specification	Unit
1	Panel Size	2.8 ”	Inch
2	Number of Pixels	240 (W) x RGB x 320 (H)	Pixels
3	Active Area	43.2 (W) × 57.6 (H)	mm
4	Pixel Pitch	0.18 (W) x 0.18 (H)	mm
5	Outline Dimension	47.7 (W) × 67.95 (H) × 2.6 (T)	mm
6	Number of Colors	262K	- -
7	Display Mode	Normally Black / Trans-Reflective	- -
8	View Direction (12/6/9/3 o’ clock)	Trans Min 30/25/25/25 (CR＞10) Refl Min 50/50/50/50 (CR＞2)	- -
9	Display Format	RGB vertical stripe	- -
10	Surface Treatment	HC (3H)	- -
11	Contrast Ratio	60(Typ.)	- -
12	Luminance (cd/m^2)	180 (Typ.)	cd/m2
13	Interface	MCU 8080 I/F or Serial I/F	- -
14	Backlight	White LED	- -
15	Driver IC	ST7789V2	- -
16	Operation Temperature	-30 ~ 80	°C
17	Storage Temperature	-30 ~ 80	°C
18	Weight	(TBD)	g

2. MECHANICAL SPECIFICATION

PIN	ASSIGNMENT
1.	VCI
2.	IOVCC
3.	IM0
4.	IM3
5.	IM2
6.	IM1
7.	/RESET
8.	VSYNC
9.	HSYNC
10.	DOTCLK
11.	ENABLE
12.	DB17
13.	DB16
14.	DB15
15.	DB14
16.	DB13
17.	DB12
18.	DB11
19.	DB10
20.	DB09
21.	DB08
22.	DB07
23.	DB06
24.	DB05
25.	DB04
26.	DB03
27.	DB02
28.	DB01
29.	DB00
30.	SDO
31.	SDA
32.	RDX
33.	WRX
34.	DCX
35.	CSX
36.	GND
37.	LED A
38.	LED K
39.	LED K
40.	NC
41.	NC
42.	NC(YD)
43.	NC(XR)
44.	NC(YU)
45.	NC(XL)



3. PIN DESCRIPTION

Pin	Symbol	I/O	Function	Note
1	VCI	P	Power supply for analog circuit (2.4~3.3V)	
2	IOVCC	P	Power supply for interface logic circuit (2.4~3.3V).	
3	IM0	I	MCU Interface select pin	(1)
4	IM3	I	MCU Interface select pin	
5	IM2	I	MCU Interface select pin	
6	IM1	I	MCU Interface select pin	
7	/RESET	I	Reset signal	
8	VSYNC	I	Vertical synchronous signal	
9	HSYNC	I	Horizontal synchronous signal	
10	DOTCLK	I	Dot Clock signal in RGB I/F	
11	ENABLE	I	Data enable	
12	DB17	I/O	Data Bus 17	
13	DB16	I/O	Data Bus 16	
14	DB15	I/O	Data Bus 15	
15	DB14	I/O	Data Bus 14	
16	DB13	I/O	Data Bus 13	
17	DB12	I/O	Data Bus 12	
18	DB11	I/O	Data Bus 11	
19	DB10	I/O	Data Bus 10	
20	DB9	I/O	Data Bus 9	
21	DB8	I/O	Data Bus 8	
22	DB7	I/O	Data Bus 7	
23	DB6	I/O	Data Bus 6	
24	DB5	I/O	Data Bus 5	
25	DB4	I/O	Data Bus 4	
26	DB3	I/O	Data Bus 3	
27	DB2	I/O	Data Bus 2	
28	DB1	I/O	Data Bus 1	
29	DB0	I/O	Data Bus 0	
30	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.	

31	SDA	I/O	-When IM3: Low, SPI interface input/output pin. -When IM3: High, SPI interface input pin. -The data is latched on the rising edge of the SCL signal. -If not used, please fix this pin at IOVCC or GND level.	
32	/RD	I	8080-Ⅰ/8080-Ⅱ: Serves as a read signal and MCU read data at the rising edge. Fix to IOVCC or GND when not in use.	
33	/WR (D/CX)	I	-8080-Ⅰ/8080-Ⅱ system: Serves as a write signal and writes data at the rising edge. - 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 IOVCC or GND.	
34	DC(SCL)	I	This pin is used to select “Data or Command” in the parallel interface. When DC = 1, data is selected. When DC = 0, command is selected. -This pin is used to be serial interface clock.	
35	/CS	I	Chip select input pin (“Low” enable).	
36	GND	-	System ground.	
37	LEDA	P	Power for LED backlight anode	
38	LEDK	P	Power for LED backlight cathode	
39	LEDK	P	Power for LED backlight cathode	
40	NC	-	No Connect	
41	NC	-	No Connect	
42	NC	-	No Connect	
43	NC	-	No Connect	
44	NC	-	No Connect	
45	NC	-	No Connect	

Note 1:

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

4. ABSOLUTE MAXIMUM RATINGS

4.1 Electrical Absolute Rating

4.1.1 TFT LCD Module

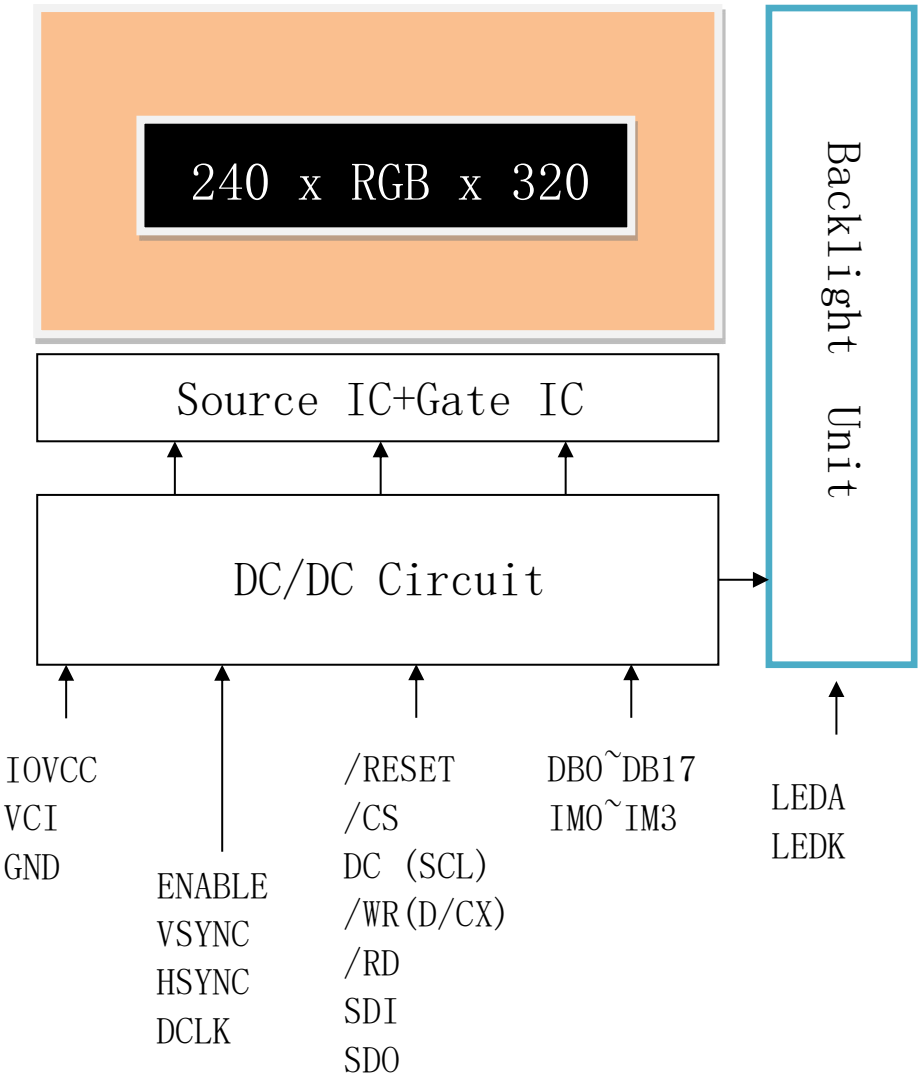
Item	Symbol	Values		Unit	Note
		Min.	Max.		
Power supply voltage	IOVCC	-0.3	4.6	V	
	VCI	-0.3	4.6	V	

4.1.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min.	Typ.	Max.		
Operating Temperature	Topa	-30		80	°C	Ambient temperature
Storage Temperature	Tstg	-30		80	°C	

5. BLOCK DIAGRAM

5.1 TFT LCD Module



6. ELECTRICAL CHARACTERISTICS

6.1 TFT LCD Module

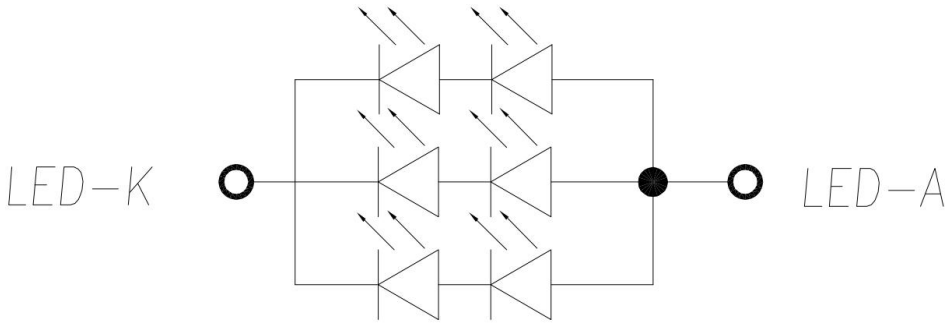
Item		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power supply voltage		VCI	2.4	2.8	3.3	V	
		IOVCC	2.4	2.8	3.3	V	
Input Voltage for logic	H Level	VIH	0.7xIOVCC	-	IOVCC	V	
	L Level	VIL	0	-	0.3xIOVCC	V	
Digital Current		ICC	-	(15)	(25)	mA	

Note (1): VCI, IOVCC=2.8V, frame =60Hz, Ta=25°C, Display pattern: Black pattern

6.2 Backlight Unit

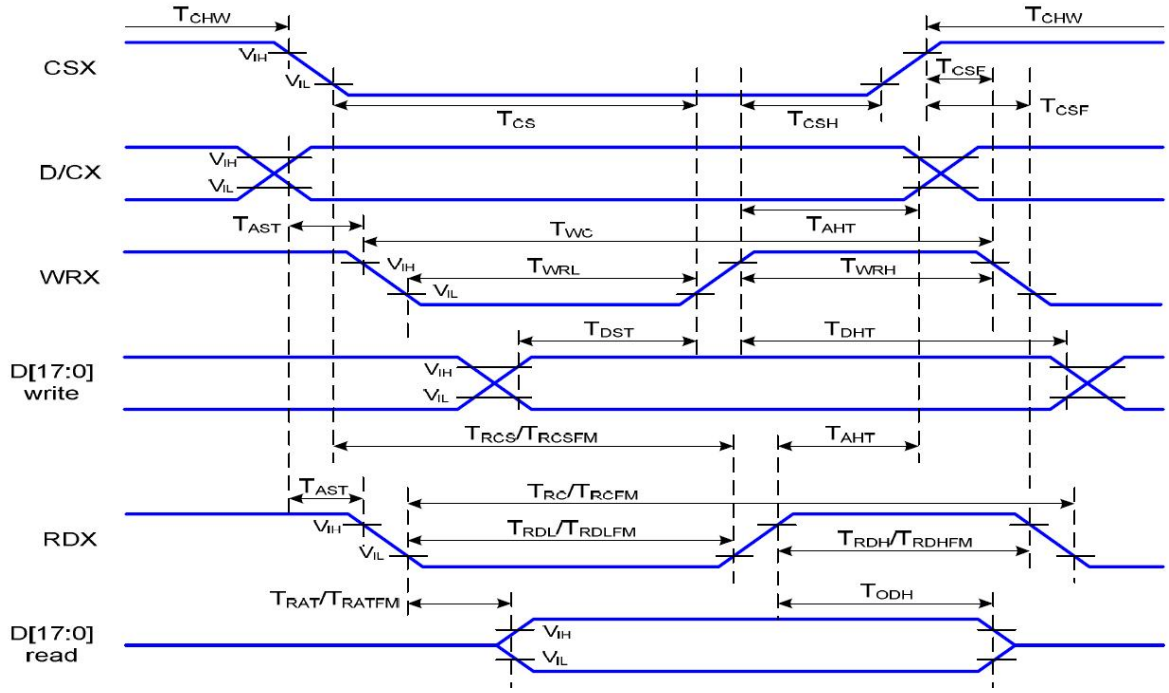
Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	-	(12.2)	-	V	
LED Current	IL	-	60	-	mA	2S2P
Power Consumption	PBL	-	732	-	mW	
LED Life Time (25℃)	-	(30000)	-	-	hr	(1)

Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25℃ 60% RH.



7. AC CHARACTERISTICS

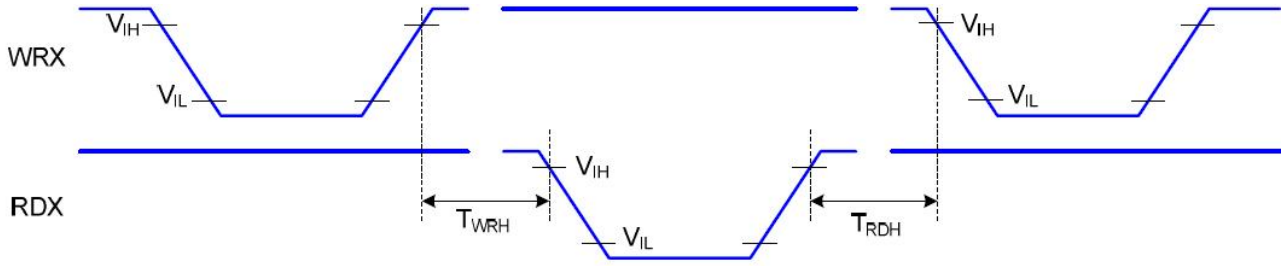
7.1 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



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

	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	

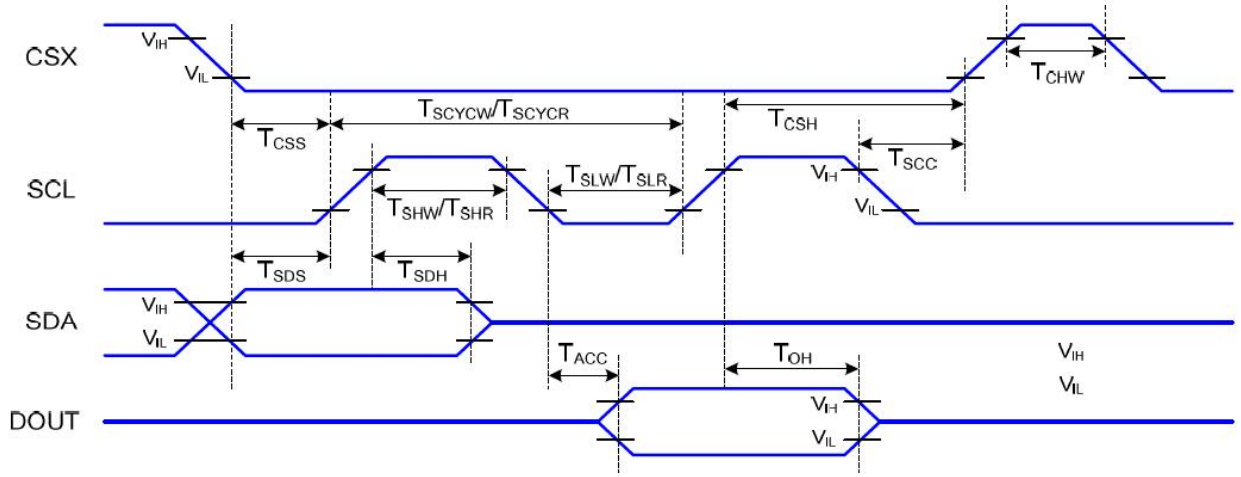
Rising and Falling Timing for I/O Signal



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

Note: The rising time and falling time (Tr, Tf) of input signal 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.

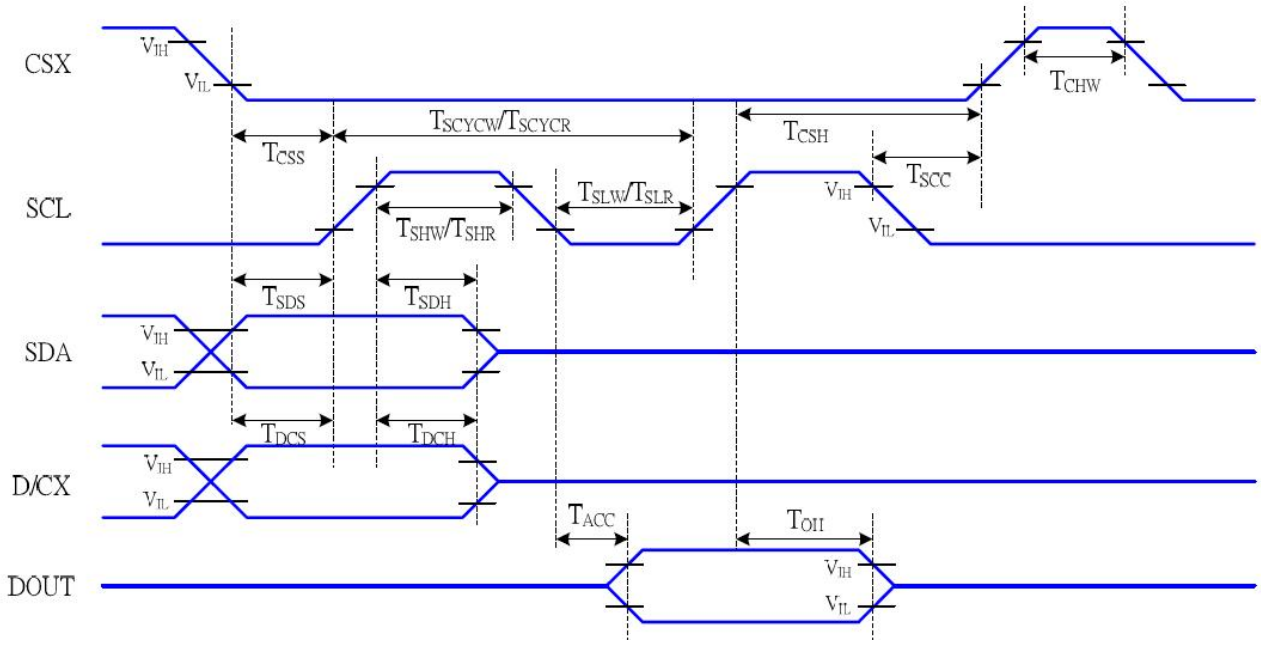
7.2 Serial Interface Characteristics (3-line serial)



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	
	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 IOVCC for Input signals.

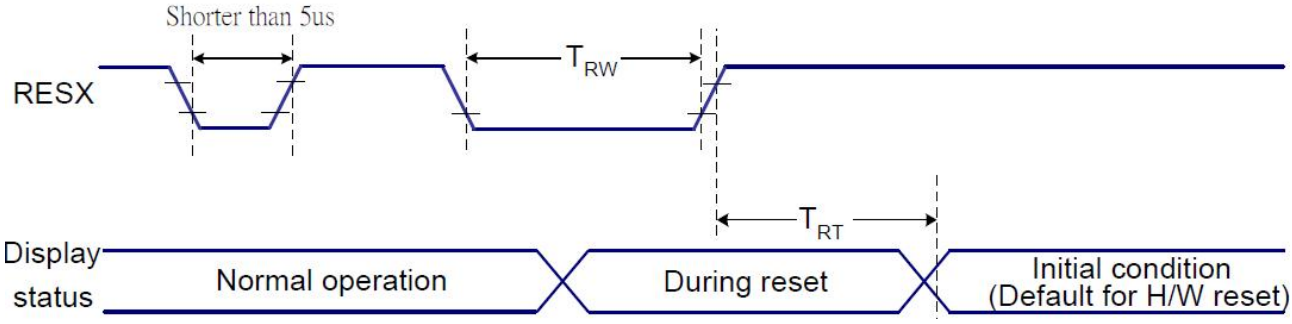
7.3 Serial Interface Characteristics (4-line serial)



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
	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 IOVCC for Input signals.

7.4 Rest timing



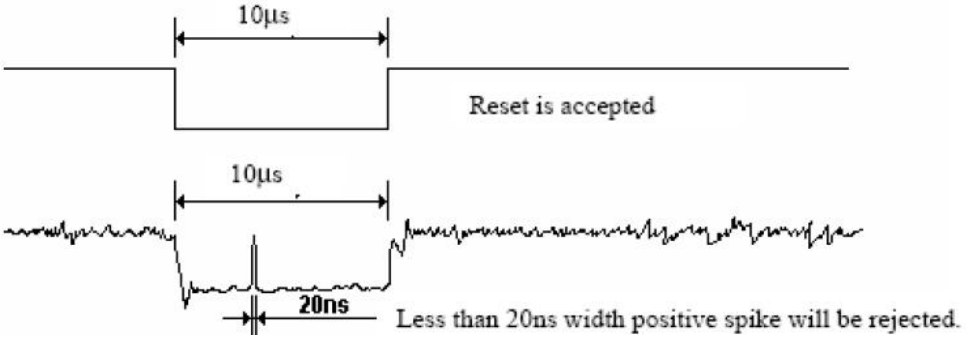
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

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:



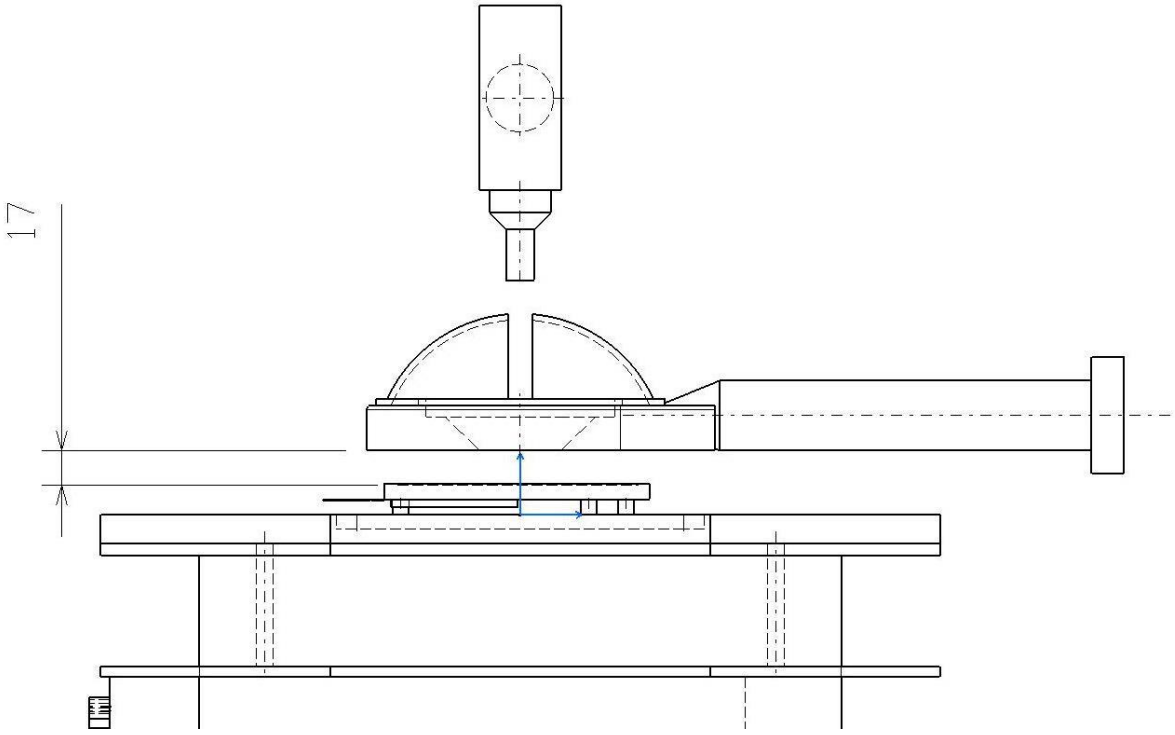
5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120 msec.

8. OPTICAL CHARACTERISTICS

Item		Symbol	Min.	Typ.	Max.	Unit
Brightness	Transmissive mode	-	150	180	-	cd/m2
Contrast Ratio	Reflective mode	CR	30	60	-	
	Transmissive mode		5	7	-	
Response Time	Reflective mode	Tr+Tf	-	-	30	ms
	Transmissive mode		-	-	30	ms
NSC	Reflective mode	S(%)	8	12	-	%
	Transmissive mode		9	14	-	%
Color Chromaticity	Reflective mode	Wx	0.281	0.311	0.341	White
		Wy	0.336	0.366	0.396	
	Transmissive mode	Wx	0.360	0.310	0.350	
		Wy	0.268	0.318	0.368	
View angle	Horizontal Reflective mode	θ x+	50	60	-	
		θ x-	50	60	-	
	Vertical Reflective mode	θ Y+	50	60	-	
		θ Y-	50	60	-	
	Horizontal Transmissive mode	θ x+	25	35	-	
		θ x-	25	35	-	
	Vertical Transmissive mode	θ Y+	30	40	-	
		θ Y-	25	35	-	

Note：The following optical specifications shall be measured in a darkroom or equivalent state(ambient luminance ≤1 lux, and at room temperature). The operation temperature is 25° C±2° C. The measurement method is shown in Note1.

Note 1: The method of optical measurement:

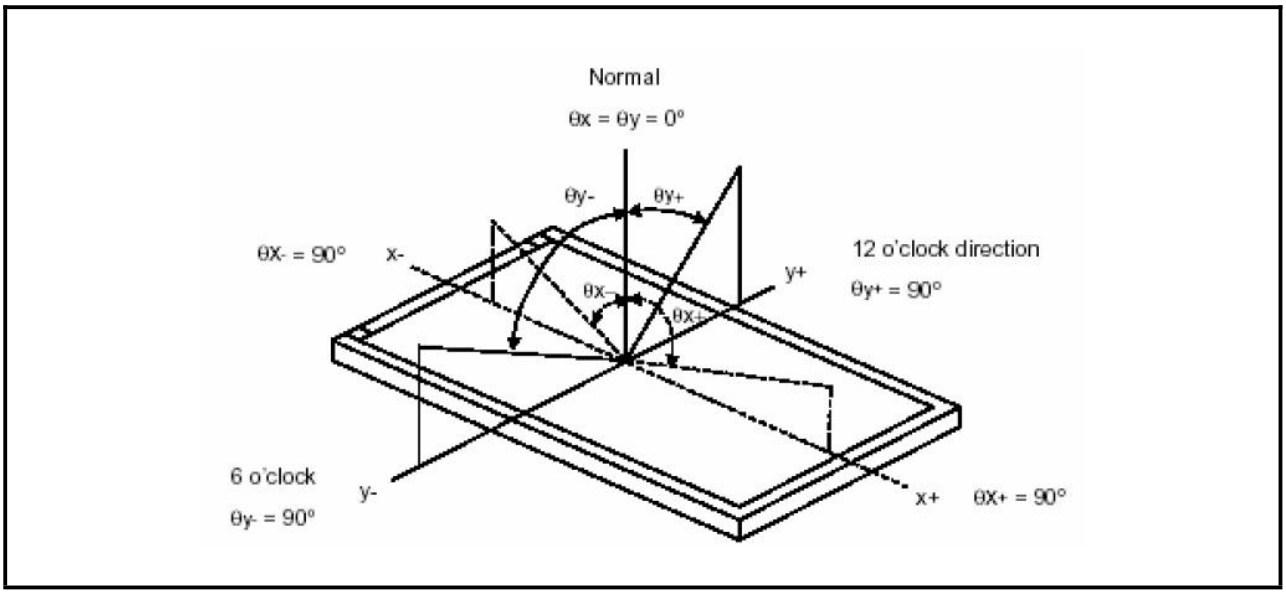


Note 2: Measured at the center area of the panel and at the viewing angle of the $\theta x = \theta y = 0°$

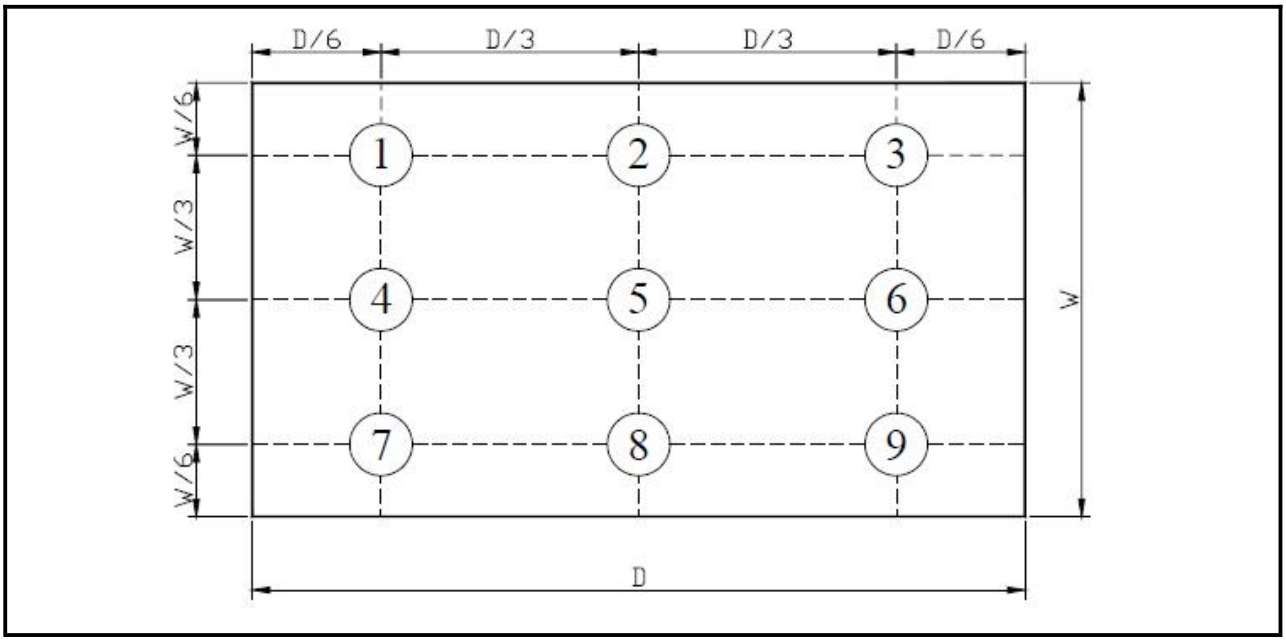
Note 3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state ÷ Luminance with all pixels in Black state

Note 4: Definition of Viewing Angle:



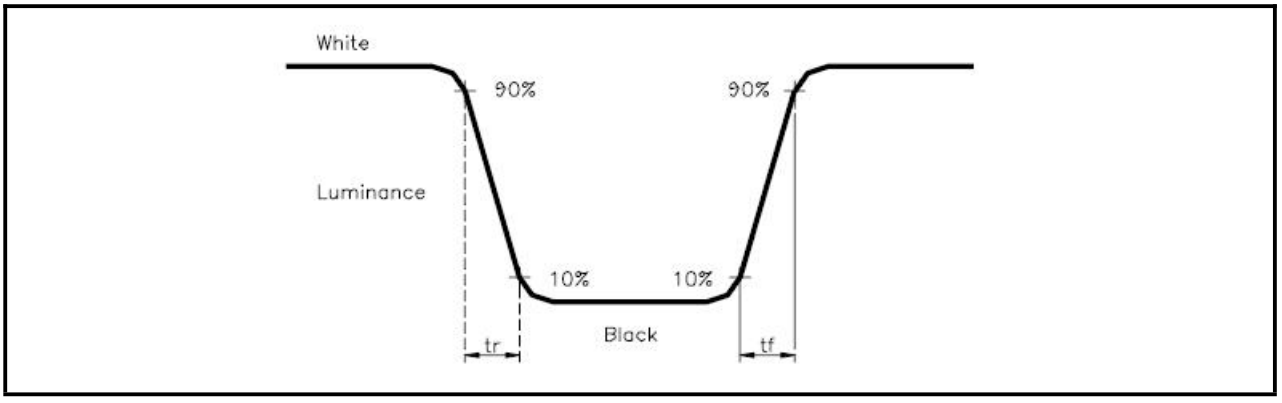
Note 5: Definition of Brightness Uniformity (B-uni):



B-uni ＝(Minimum luminance of 9 points÷Maximum luminance of 9points)X100%

Note 6: Definition of Response Time:

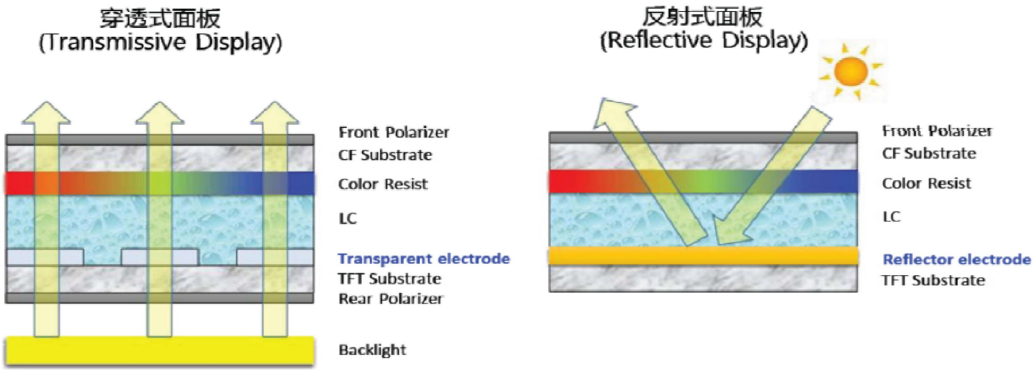
The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure



Note 7: Definition of Chromaticity:

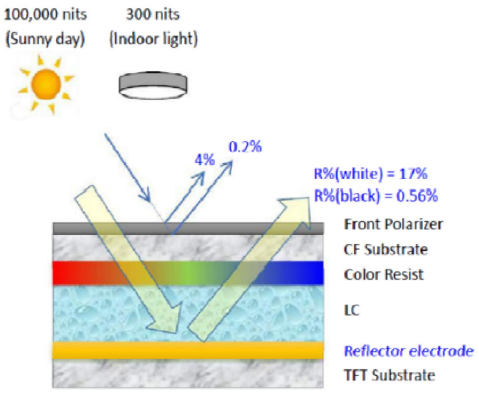
The color coordinates (Wx,Wy),(Rx,Ry),(Gx,Gy),and (Bx,By) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Transmissive VS Reflectance display characteristics :



Transmissive vs. Reflective LCD Visibility

Reflective LCD under stronger light

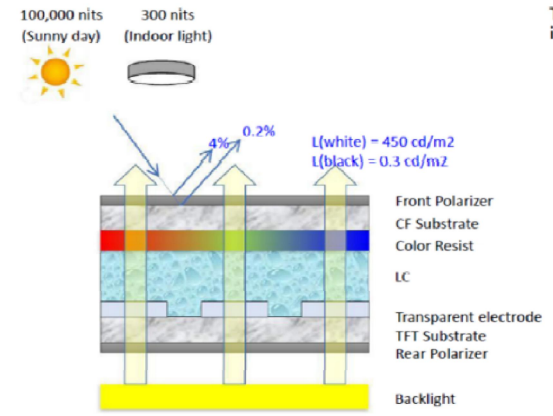


Display reflected light intensity > Surface reflectied light intensity

$$CR = \frac{(100{,}000 \text{ or } 300) \times 17\%}{(100{,}000 \text{ or } 300) \times 0.56\%} = \text{keep } 30.35$$

- Perfect readability under any ambient light conditions
- No need for backlight, with advantages of lightweight, energy-saving, power-saving, and eye protection
- Adequate ambient light sources are required to ensure readability

Transmissive LCD under stronger light



The intensity of light reflected on the surface is greater than the intensity of light transmitted through it

$$CR = \frac{(100{,}000 \text{ or } 300) \times 4.2\% + 450}{(100{,}000 \text{ or } 300) \times 4.2\% + 0.3} = 1.11 \text{ or } 35.86$$

- Penetrating displays are suitable for indoor use and can be viewed in sunlight Poor readability
- Improving surface brightness can enhance outdoor readability, but there are some limitations

- Disadvanages :

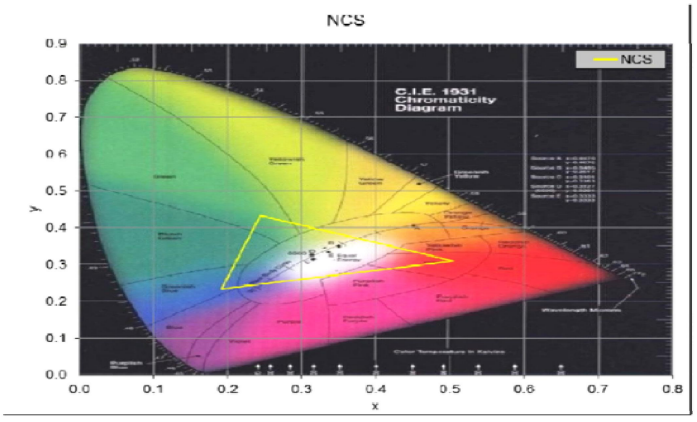
- Relative increase in backlight power consumption
- **The increase in backlight current is prone to overheating**
- Increased backlight thickness

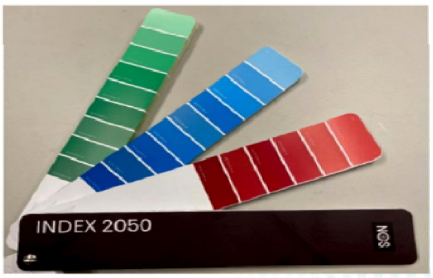
Note 9: Ambient brightness reference

Place/Environment	photometric quantity	Place/Environment	photometric quantity
fine weather	30000~300000 lux	Night street lamp	0.1 lux
Indoor on sunny days	100~1000 lux	Producing department	10~500 lux
overcast sky	3000~10000 lux	Office	30~50 lux
Outdoors on cloudy days	5~500 lux	Dining room	10~30 lux
Indoor overcast	5~50 lux	Corridor	5~10 lux
Dusk indoor	10 lux	Parking lots	1~5 lux
Sunrise Sunset	300 lux	60cm from 60W desk lamp	300 lux
The Dark Night	0.001~0.02 lux	Indoor fluorescent lamp	100 lux
Moonlit night	0.02~0.3 lux	A TV studio	1000 lux
Full moon	0.30~0.03 lux	black and white TV set fluorescent screen	120 lux
Starlight	0.0002~0.00002 lux	colour tv set fluorescent screen	80 lux
Dark night	0.003~0.0007 lux	The amount of lighting required to read book	50~60 lux

NCS(Natural Color System)色域

HannStar





	NCS code	Y(R%)	x	y
Color	NCS_1080-R	15.118	0.5050	0.3093
	NCS_2565-G	20.373	0.2442	0.4334
	NCS_2065-B	18.156	0.1925	0.2346

Base on CMF 1931 / D65 illuminant

9. RELIABILITY

9.1 Test Condition

9.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 25 ± 5° C

Humidity : 65 ± 5%

9.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

9.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

9.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

9.2 TESTS

No.	ITEM	CONDITION CRITERION
1	High Temperature Storage	80°C, 120 hrs
2	Low Temperature Storage	-30°C, 120 hrs
3	High Temperature Operating	80°C, 120 hrs
4	Low Temperature Operating	-30°C, 120 hrs
5	High Temperature/Humidity Non-Operating	50°C, 90%RH, 120 hrs
6	Temperature Shock Non-Operating	-30°C ←→ 80°C (0.5hr each), 25 cycles
7	Vibration Test Non-Operating	Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

9.3 JUDGMENT STANDARD

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

9.4 INCOMING INSPECTION STANDARDS

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td rowspan="6">1</td><td rowspan="6">Operating</td><td>Display function: No Display malfunction (Major)</td></tr>
<tr><td>Contrast ratio (Black, White):
Does not meet specified range in the spec. (Major) (Note:3)</td></tr>
<tr><td>Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)</td></tr>
<tr><td>Point Defect : Active area ≤ 5 dots (Minor) (Note:1)
<table>
<tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr>
<tr><th>Active Area</th></tr>
<tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr>
<tr><td>Dark</td><td>4</td></tr>
</table></td></tr>
<tr><td>Non-uniformity: Visible through 5%ND filter. (Minor)</td></tr>
<tr><td>Foreign material in Black or White spots shape (W>1/4L)
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>D> 0.5</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr>
<tr><td>0.3 < D ≤ 0.5</td><td>5</td></tr>
<tr><td>D ≤ 0.3</td><td>*</td></tr>
</table>
D = (Long + Short) / 2 ＊: Disregard</td></tr>
<tr><td>Foreign Material in Line or spiral shape (W≤1/4L) (Note: 4)
<table>
<tr><th>L (mm) / Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>L >5</td><td>W>0.1</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr>
<tr><td>0.5 < L ≤ 5</td><td>0.03 < W≤0.1</td><td>5</td></tr>
<tr><td>L ≤0.5</td><td>W≤0.03</td><td>*</td></tr>
</table>
L : Length W : Width ＊: Disregard</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">External Inspection (non-operating)</td><td>Dimension: Outline (Major)</td></tr>
<tr><td>Bezel appearance: uneven (Minor)</td></tr>
<tr><td>Scratch on the polarize: (Note:2)
<table>
<tr><th>L (mm) / Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>--</td><td>W>0.1</td><td>0</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td>L ≤ 3</td><td>W≤0.1</td><td>3</td></tr>
</table>
L : Length W : Width ＊: Disregard
Dent or bubble on the polarize (Note:2)
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>D≤0.3</td><td>*</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td>D≤0.5</td><td>3</td></tr>
</table>
D = (Long + Short) / 2 ＊: Disregard</td></tr>
</table>

Class of defects	**Major**	AQL 0.65%	**Definition** It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

Note1:

(a)Bright point defect is defined as point defect of R,G,B with area >1/2 pixel respectively

(b)Dark point defect is defined as visible in full white pattern.

(c)Definition of distribution of point defect is as follows:

-minimum separation between dark point defects should be larger than 5mm.

-minimum separation between bright point defects should be larger than 5mm.

(d)Definition of joined bright point defect and joined dark point defect are as follows:

-Two or more joined bright point defects must be nil.

-Three joined dark point defects must be nil.

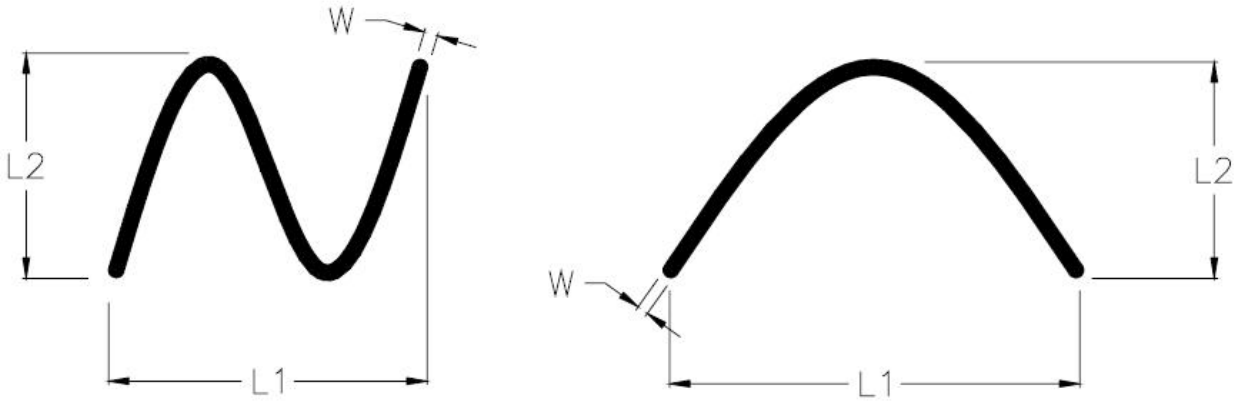
-Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.

-Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance 30± 5cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance 50± 5cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



9.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

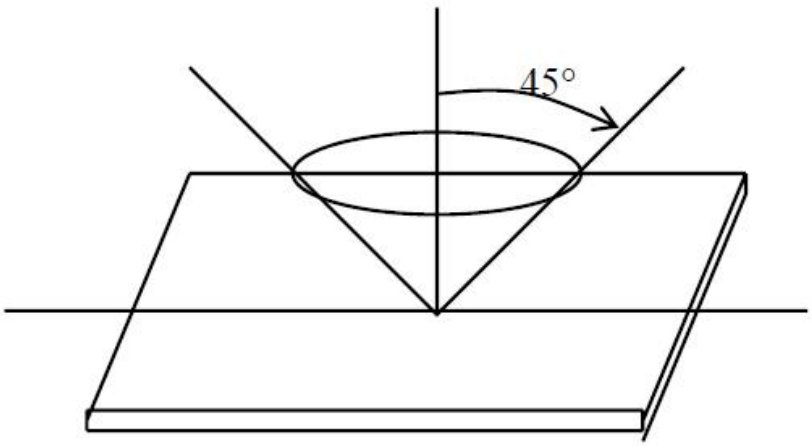
Inspection level: Level II

9.6 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.

θ ≤45° inspection under non-operating condition.

θ ≤5° inspection under operating condition



10. PRECAUTION RELATING PRODUCT HANDLING

10.1 SAFETY

10.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

10.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

10.2 HANDLING

10.2.1 Avoid any strong mechanical shock which can break the glass.

10.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.

10.2.3 Do not remove the panel or frame from the module.

10.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

10.2.5 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.

10.2.6 Do not touch the display area with bare hands , this will stain the display area.

10.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

10.2.8 To control temperature and time of soldering is 280 ± 10°C and 3-5 sec.

10.2.9 To avoid liquid (include organic solvent) stained on LCM.

10.3 STORAGE

10.3.1 Store the panel or module in a dark place where the temperature is 25°C ± 5°C and the humidity is below 65% RH.

10.3.2 Do not place the module near organics solvents or corrosive gases.

10.3.3 Do not crush, shake, or jolt the module.