LCD MODULE SPECIFICATION

Customer: _____

Module No.: _____

Date: **2023-09-23**

Version: **0.1**

■ **Pre-Specification for parameter checking**

□ **Final-Specification for sample approval**

For Customer's Acceptance:

Approved by	**Comment**

Table of Contents

Record of Revision

Rev.	Date	Description	Editor
0.1	2023-09-23	First release	

1 General Specifications

No.	Item	Specification	Remark
1	LCD Size	4.3 inch (Diagonal)	
2	Driver Element	a-Si TFT active matrix	
3	Resolution	480 (RGB) ×272	
4	Display Mode	Normally Black, Transmissive	
5	Pixel Pitch	0.066 (H) × 0.198 (V)	
6	Display Colors	65K/262K	
7	Surface Treatment	--	
8	Color Arrangement	RGB-Stripe	
9	Interface	MCU8/9/16Bit; 3/4-line/Dual SPI; QSPI (Optional)	
10	Viewing Direction	ALL	
11	Gray Scale Inversion Direction	--	Note 1
12	Outline Dimension (mm)	105.50 (W) ×67.20 (H) × 4.74(T)	
13	Active Area (mm)	95.04 (W) ×53.86 (H)	
14	Touch Screen	With CTP	
15	Display Driver IC		
16	Touch Driver IC	GT911	

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180°shift.

Note 2: RoHS compliant.

2 Pin Assignment

2.1 LCD Pin assignment

Match connector: XF2M-4015-1A（OMRON）or equivalent.

PIN	Symbol	I/O	Description	Remark
1	LEDK	P	LED Cathode	
2	LEDA	P	LED anode	
3	GND	P	Power Ground	
4	SPI4W	I	Std SPI 3/4 wire selection. SPI4W="H", 4 wire SPI; SPI4W="L", 3wire SPI.	
5	DB0	I/O	MCU parallel interface data bus DB0.	
6	DB1	I/O	MCU parallel interface data bus DB1.	
7	DB2	I/O	MCU parallel interface data bus DB2.	
8	DB3	I/O	MCU parallel interface data bus DB3.	
9	DB4	I/O	MCU parallel interface data bus DB4.	
10	DB5	I/O	MCU parallel interface data bus DB5.	
11	DB6	I/O	MCU parallel interface data bus DB6.	
12	DB7	I/O	MCU parallel interface data bus DB7.	
13	DB8	I/O	MCU parallel interface data bus DB8.	
14	DB9	I/O	MCU parallel interface data bus DB9.	
15	DB10	I/O	MCU parallel interface data bus DB10.	
16	DB11	I/O	MCU parallel interface data bus DB11.	
17	TE	O	Tearing effect output pin is used to synchronize MCU frame writing,	
18	DB12	I/O	MCU parallel interface data bus DB12.	
19	DB13	I/O	MCU parallel interface data bus DB13.	
20	DB14	I/O	MCU parallel interface data bus DB14.	
21	DB15	I/O	MCU parallel interface data bus DB15.	
22	GND	P	Power Ground	
23	RESET	I	This signal will reset the device and it must be applied to properly initialize the chip,Signal is active low.	
24	WRX/SPI CLK	I	Write enable in MCU parallel interface; In Serial Interface, this is used as SCL.	
25	SPI-SDA	I/O	Serial input/output signal in serial interface mode.	
26	CS	I	Chip Selection Pin	
27	GND	P	Power Ground	
28	RDX	I	Read enable in 8080 MCU parallel interface.Fix to IOVCC level when not in use	
29	DCX/SPI RS	I	Data/command selection pin in parallel /4-line serial interface.	
30	GND	P	Power Ground	

31	IM1	I	Select interface mode :MCU8/16Bit; 3/4-line/Dual SPI; QSPI .	Note1
32	IM0	I	Select interface mode :MCU8/16Bit; 3/4-line/Dual SPI; QSPI.	Note1
33	VDDIO	P	Power supply for digital interface I/O pins	
34	VDD	P	LCM Power Supply .	
35	GND	P	Power Ground	
36	NC	-	No connection.	
37	NC	-	No connection.	
38	NC	-	No connection.	
39	NC	-	No connection.	
40	NC	-	No connection.	

I---Input, O---Output, P--- Power/Ground

Note1:Selection of these interface are set by IM<1:0> ,SPI4W pins as shown below Table:

SPI4W	IM1	IM0	Interface	Read Back Data Bus Selection
0	0	0	8080 series 8bit	DG3-2, DB7-2
			8080 series 9bit	DG4-2, DB7-2
			8080 series 16bit	DR5-2, DG7-2, DB7-2
0	0	1	3-wire Std SPI	SDA: In/Out
0	1	0	Dual SPI	SDA:In/Out DCX:In
0	1	1	Quad SPI	SDA:In/Out SDA/ SDO1 DCX:In DCX/SDO2 DB[0]:In SDO3 DB[1]:In SDO4
1	0	1	4 -wire Std SPI	SDA: In/Out ,DCX

2.2 Touch panel pin assignment

Match connector: XF2M-1015-1A by OMRON or equivalent

No.	Symbol	Description
1	GND	Ground
2	TP_VDD	TP 3.3V Power
3	SCL	I2C _SCL(2.8~3.3V), 4.7K~10K pull up resistor needed
4	NC	No connection
5	SDA	I2C_SDA (2.8~3.3V),4.7K~10K pull up resistor needed
6	NC	No connection
7	/RST	External reset(2.8~3.3V)
8	NC	No connection
9	INT	External interrupt (2.8~3.3V)
10	GND	Ground

3 Absolute Maximum Ratings

Ta = 25℃

Item	Symbol	Min.	Max.	Unit	Remark
Power Voltage	VDD	-0.30	+4.6	V	
	VDDIO	-0.30	+4.6	V	
	TP-VDD	-0.50	3.6	V	
Operating Temperature	Top	-30.0	85.0	℃	
Storage Temperature	T_{st}	-30.0	85.0	℃	
Operating and Storage Humidity	H_{stg}	10%	90%	%(RH)	

4. Electrical Characteristics

4.1 Recommended Operating Condition

VDD=3.3V，GND=0V，Ta = 25℃

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VDD	3.0	3.3	3.6	V	
		VDDIO	1.65	3.3	3.6	V	
TP Power		TP-VDD	2.8	3.0	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0	-	0.3 x VDDIO	V	
	High Level	V_{IH}	0.7 x VDDIO	-	VDDIO	V	
Current of Power supply		I_{VDD}	-	28	40	mA	VDD=3.3V, color bar pattern
		I_{VDDIO}	-	1	5	mA	VDDIO=3.3V, color bar pattern

4.2 Backlight Unit Driving Condition

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I_F	-	40	50	mA	10 LEDs (5 LED Serial, 2 LED Parallel)
Forward Current Voltage	V_F	-	16	17	V	
Backlight Power Consumption	W_{BL}	-	640	850	mW	
Operating Life Time	--	30000	--	--	hrs	Note 2, Note 3

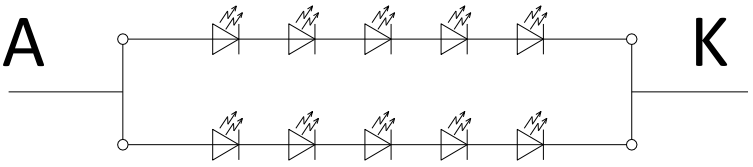
Note1: The LED driving condition is defined for each module (5LED Serial, 2 LED Parallel).

Note2: When LCM is operated, the stable forward current should be inputted. And forward voltage is for reference only.

Note3: Optical performance should be evaluated at Ta=25℃ When LED is driven at high current, high

ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

Note4: The LED driving condition is defined for each LED module.

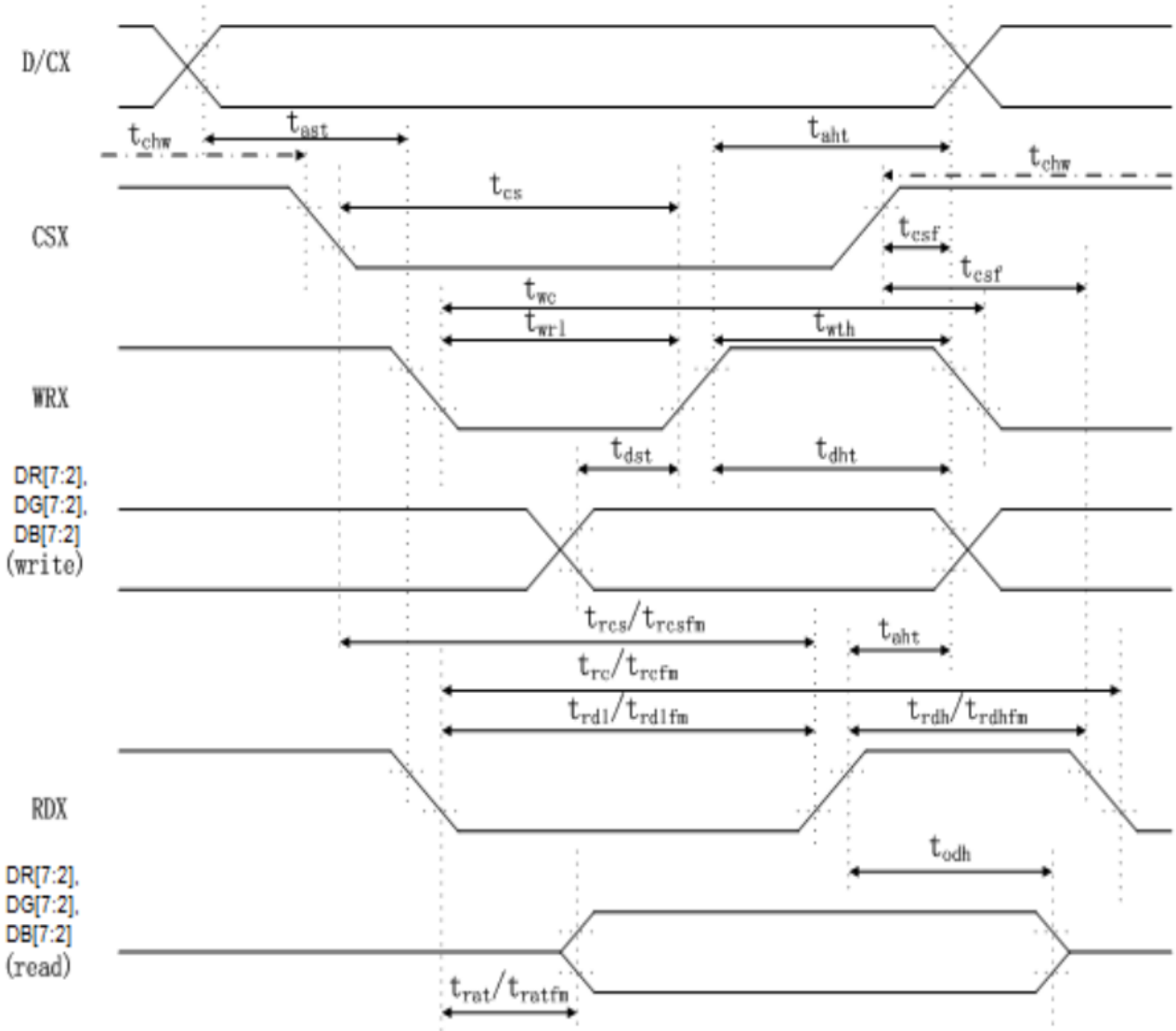


16V,40MA(TYP)

5 Timing Chart

5.1 Parallel 8/9/16 bit Interface Characteristics.

(Note: DB[7:2] =D5~D0; DG[7:2] =D11~D6; DR[5:2] =D15~D12)



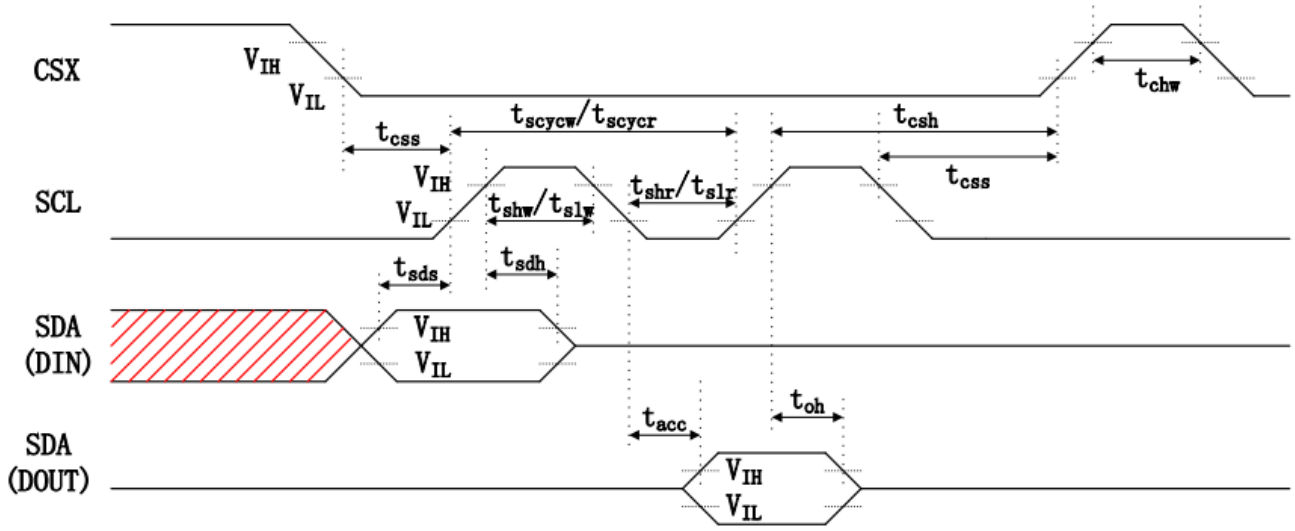
Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
D/CX	T_{AST}	Address Setup Time	0		ns	
	T_{AHT}	Address Hold Time (W/R)	10		ns	
CSX	T_{CHW}	"S" "H" Pulse Width	25		ns	
	T_{CS}	Chip Select Setup Time(W)	10		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 (W/R)	10		ns	
WRX	T_{WC}	Write Cycle	50		ns	MCU 16 Bit Format (5-6-5): Twc>100ns (see "6.4.8.") MCU 16 Bit Format (6-6-6): Twc>66ns (see "6.4.9." Figure 6.4.9.4) Other Format Twc>50ns
	T_{WRH}	Control Pulse H Duration	T_{WC} /2		ns	
	T_{WRL}	Control Pulse L Duration	T_{WC} /2		ns	
RDX	T_{RC}	Read Cycle(ID)	160		ns	When Read ID
	T_{RDH}	Control Pulse H Duration(ID)	T_{RC} /2		ns	
	T_{RDL}	Control Pulse L Duration(ID)	T_{RC} /2		ns	
RDX	T_{RCFM}	Read Cycle(FM)	450		ns	When Read From Frame Memory
	T_{RDHFM}	Control Pulse H Duration(FM)	T_{RCFM} /2		ns	
	T_{RDLFM}	Control Pulse L Duration(FM)	T_{RCFM} /2		ns	
DR[7:2], DG[7:2], DB[7:2]	T_{DST}	Data Setup Time	10		ns	CLmax=30pF Clmin=8pF
	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	

Note 1: IOVCC 1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C (to +85°C no damage)

Note 2: This input signal rise time and fall time (Tr, Tf) is specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of IOVCC for input signals

5.2 3/4-SPI/Dual-SPI/Quad-SPI Interface Characteristics.



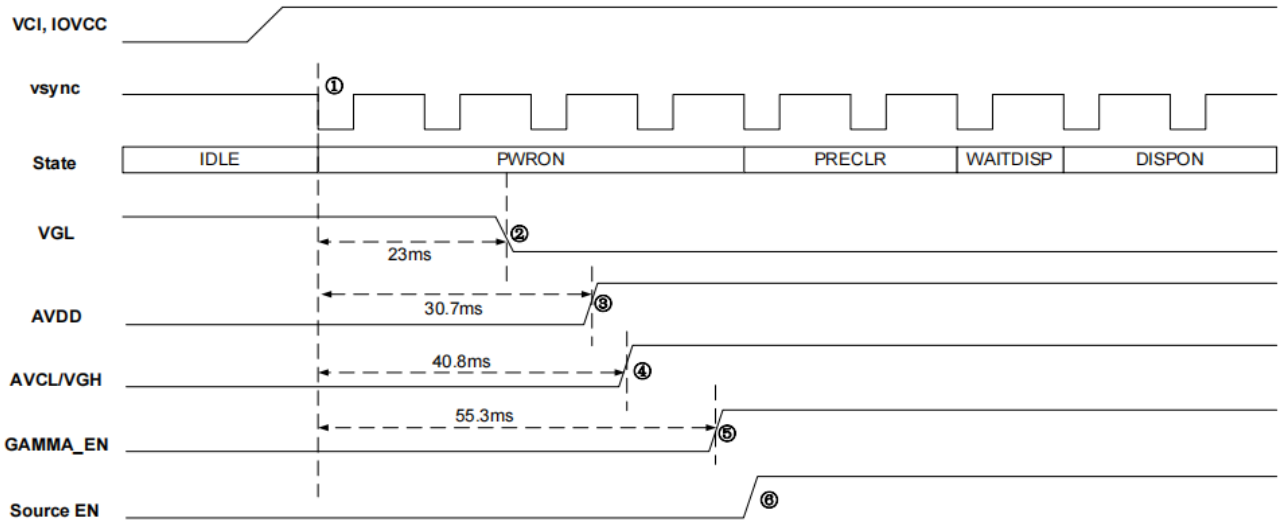
Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	T_{CSS}	Chip Select Setup Time	10		ns	
	T_{CSH}	Chip Select Hold Time	30		ns	
	T_{CHW}	Chip Select "H" Pulse Width	30		ns	
SCL	T_{SCYCW}	Serial Clock Cycle(Write)	12.5		ns	QSPI 4 lane format (5-6-5): T_{SCYCW} >25ns (see "6.4.12.") QSPI 4 lane format (6-6-6): T_{SCYCW} >16ns(see "6.4.13") Other Format T_{SCYCW} >12.5ns
	T_{SHW}	S"L" "H" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SLW}	S"L" "L" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SCYCR}	Serial Clock Cycle(Read)	150		ns	
	T_{SHR}	S"L" "H" Pulse Width(Read)	T_{SCYCR} /2		ns	
	T_{SLR}	S"L" "L" Pulse Width(Read)	T_{SCYCR} /2		ns	
SDA(DIN) /(DOUT)	T_{SDS}	Data Setup Time	5		ns	
	T_{SDH}	Data Hold Time	5		ns	
	T_{ACC}	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	T_{OH}	Output Disable Time	10		ns	

Note 1: IOVCC=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)
Note 2: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 10% and 90% of IOVCC for Input signals.

4-SPI Interface Characteristics:

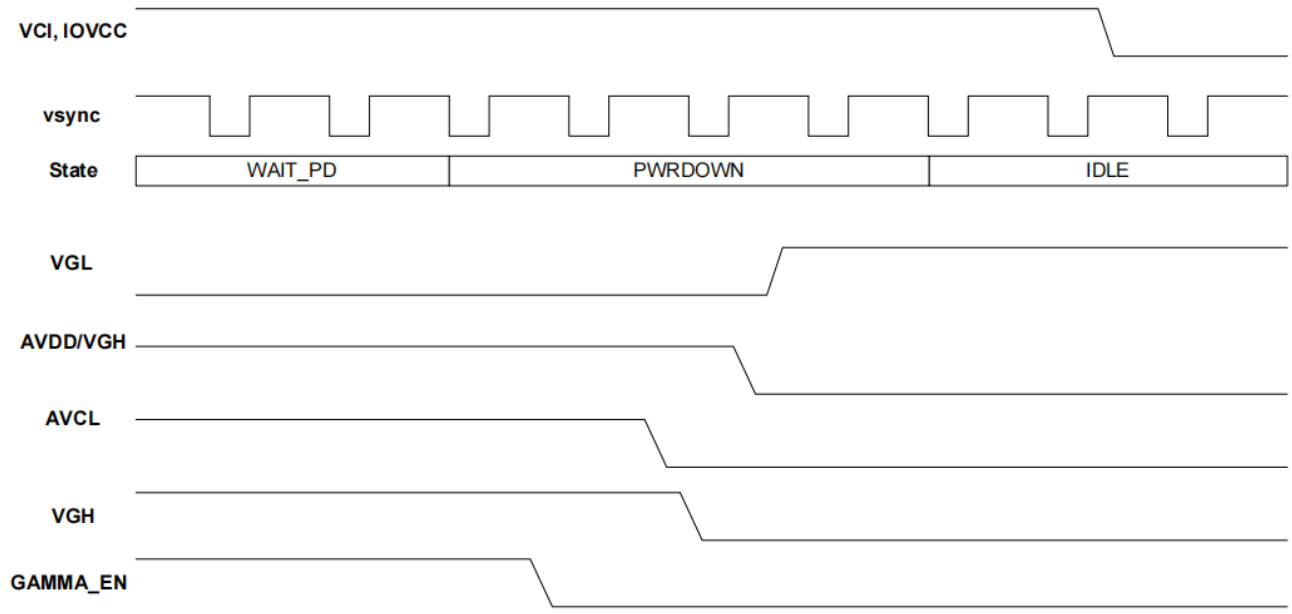
Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	T_{CSS}	Chip Select Setup Time	10		ns	
	T_{CSH}	Chip Select Hold Time	30		ns	
	T_{CHW}	Chip Select "H" Pulse Width	30		ns	
SCL	T_{SCYCW}	Serial Clock Cycle(Write)	12.5		ns	
	T_{SHW}	S "L" "H" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SLW}	S "L" "L" Pulse Width(Write)	T_{SCYCW} /2		ns	
	T_{SCYCR}	Serial Clock Cycle(Read)	150		ns	
	T_{SHR}	S "L" " H" "Pulse Width(Read)	T_{SCYCR} /2		ns	
	T_{SLR}	S"L" "L" Pulse Width(Read)	T_{SCYCR} /2		ns	
D/CX	T_{DCS}	D/CX Setup Time	5		ns	
	T_{DCH}	D/CX Hold Time	5		ns	
SDA(DIN) (DOUT)	T_{SDS}	Data Setup Time	5		ns	
	T_{SDH}	Data Hold Time	5		ns	
	T_{ACC}	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	T_{OH}	Output Disable Time	10		ns	

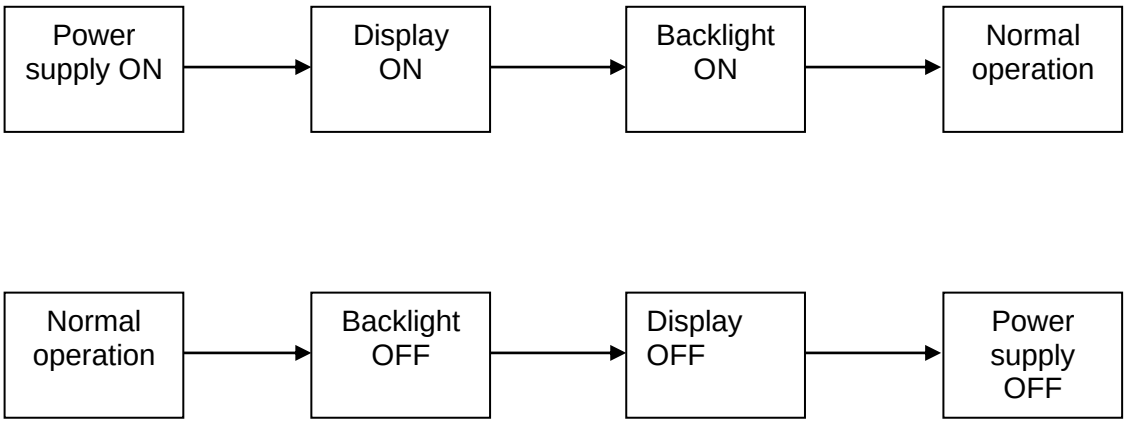
5.3 Power ON Timing (VDD=VCI,VDDIO=IOVCC)



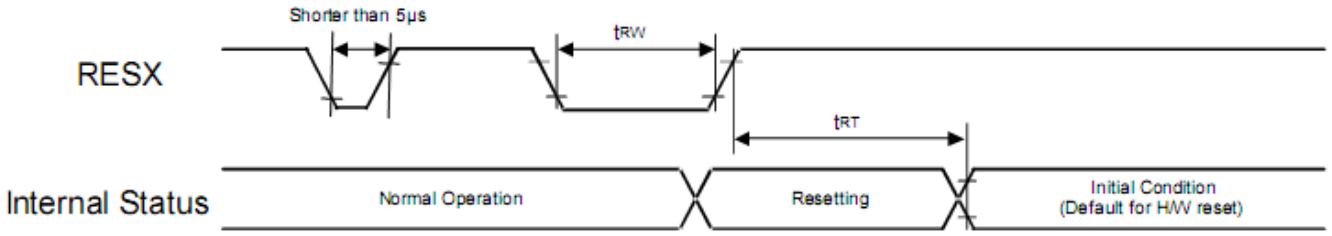
No.	Description	Min. Time
1	After VCI/IOVCC become stable , reset finished and host send command “11H”	Decide by host 11H command
2	VGL from 0V to -11.5V	23ms
3	AVDD from VCI to 6.6V	30.7ms
4	AVCL from 0 to -5V and VGH from AVDD to 15.4	40.8ms
5	Gamma output enable	55.3ms
6	Source output enable	Decide by host “29H” command

5.4 Power OFF Timing (VDD=VCI)





5.5 Reset Timing



Symbol	Parameter	Related pins	Min.	Max.	Unit
t_{RW}	Reset pulse width(2)	RESX	10	-	µs
t_{RT}	Reset complete time(3)	-	-	5	ms
		-	-	120	ms

6 Optical Characteristics

Ta=25℃

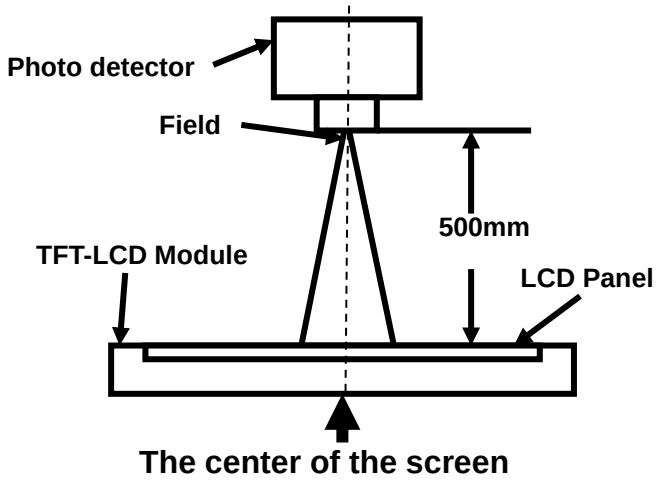
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
View Angles		θT	CR≧10	80	85	-	Degree	Note 2
		θB		80	85	-		
		θL		80	85	-		
		θR		80	85	-		
Contrast Ratio		CR	θ=0°	800	1000	-		Note1 Note3
Response Time		T_{ON}	25℃	-	30	35	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.246	0.276	0.306		Note1 Note5
		y		0.255	0.285	0.315		
	Red	x		0.529	0.559	0.589		
		y		0.282	0.312	0.342		
	Green	x		0.315	0.345	0.375		
		y		0.548	0.578	0.608		
	Blue	x		0.121	0.151	0.181		
		y		0.058	0.088	0.118		
Uniformity		U		-	80	-	%	Note1 Note6
NTSC				-	50	-	%	Note 5
Luminance		L		-	450	-	cd/m^2	Note1 Note7

Test Conditions:

1. I_F= 40 mA, V_F=16.0 V and the ambient temperature is 25±2℃.humidity is 65±7%
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

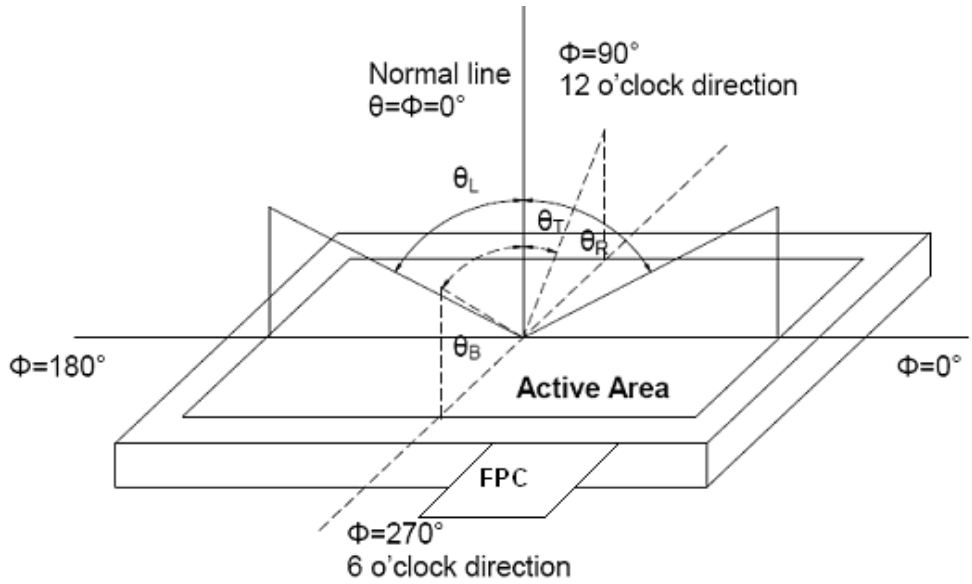
Properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A or similar equipment	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

Note 2: Definition of viewing angle range and measurement system.

Viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。



Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

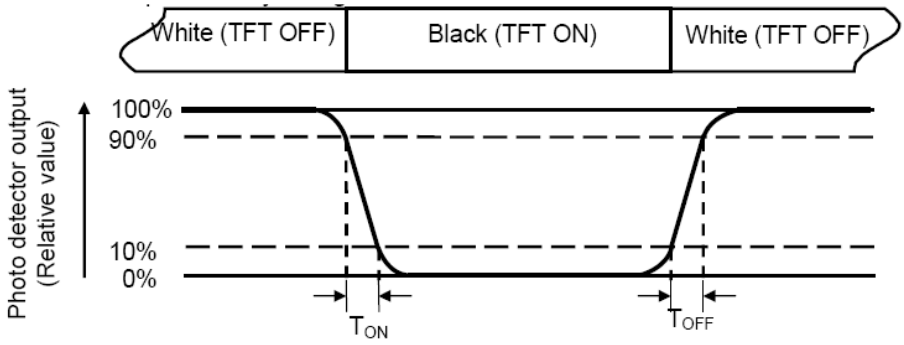
"White state ": The state is that the LCD should drive by Vwhite.

"Black state": The state is that the LCD should drive by Vblack.

Vwhite: To be determined Vblack: To be determined.

Note 4: Definition of response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

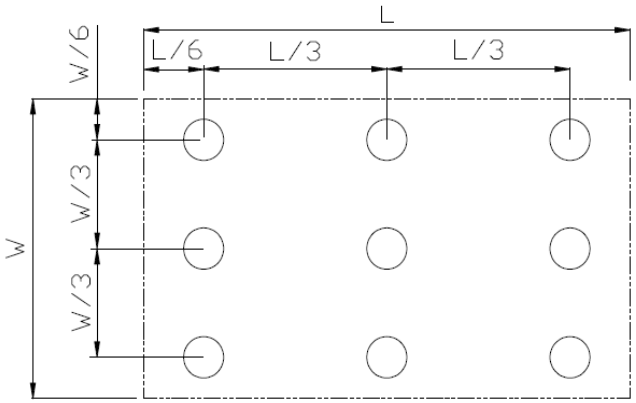
Color coordinates measured at center point of LCD.

Note 6: Definition of luminance uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = Lmin/ Lmax

L-------Active area length W----- Active area width



Lmax: The measured Maximum luminance of all measurement position.

Lmin: The measured Minimum luminance of all measurement position.

Note 7: Definition of luminance:

Measure the luminance of white state at center point.

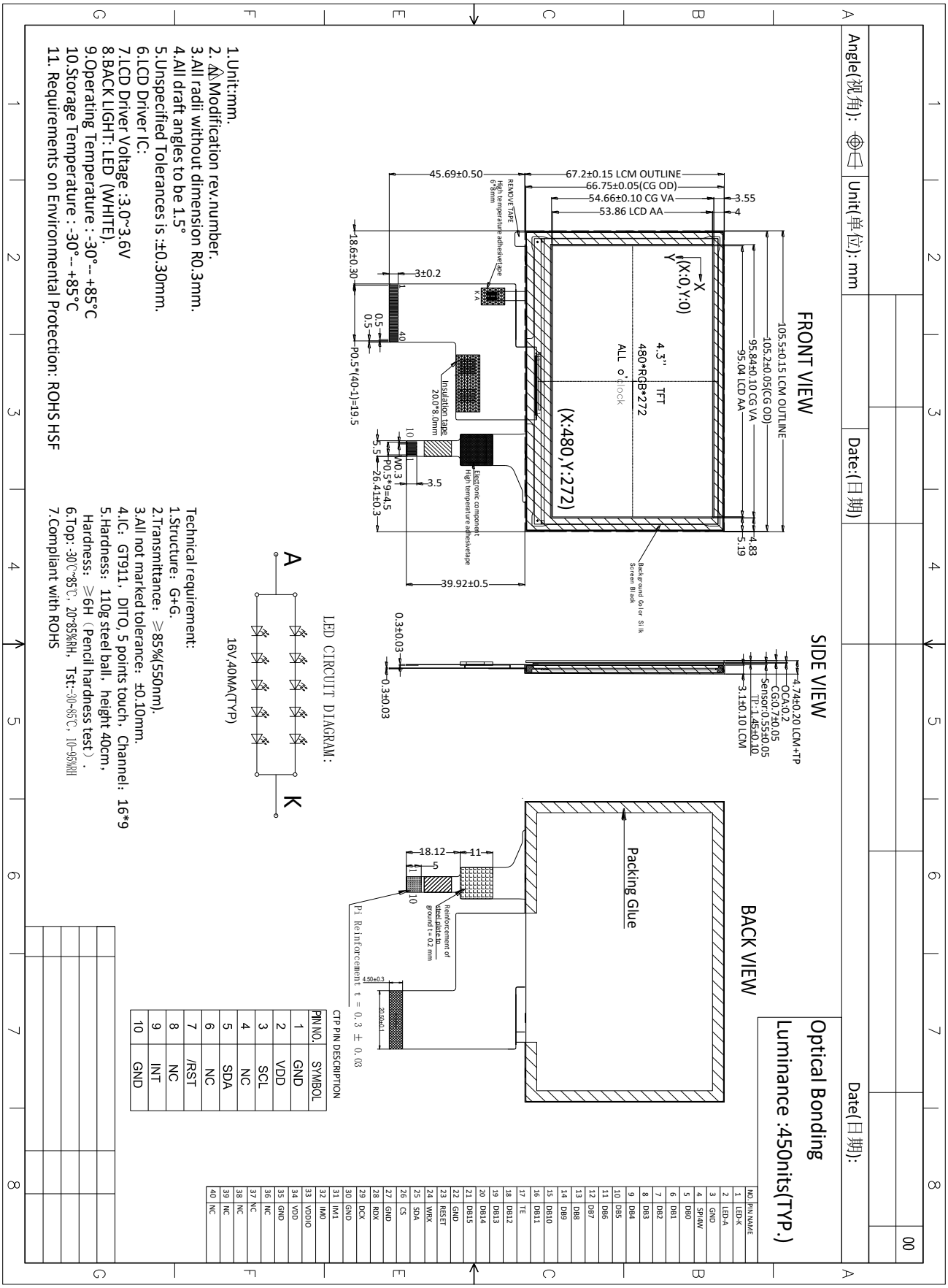
7 Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts = +85℃, 240 hours	No abnormalities in functions
2	Low Temperature Operation	Ta = -30℃, 240 hours	No abnormalities in functions
3	High Temperature Storage	Ta = +85℃, 240 hours	No abnormalities in functions
4	Low Temperature Storage	Ta = -30℃, 240 hours	No abnormalities in functions
5	Storage at High Temperature and Humidity	Ta = +60℃, 90% RH max,240hours	No abnormalities in functions
6	Thermal Shock (non-operating)	-30℃ 30 min~ +70℃ 30 min, Change time: 0.5 hour ← 5 min → 0.5 hour.10 Cycle	Start with cold temperature, End with high temperature,
7	ESD	C=150pF, R=330Ω,5point/panel Air: ±8Kv, 5times; Contact:±4Kv,5times (Environment:15℃~35℃, 30%~60%.86Kpa~106Kpa)	No abnormalities in functions

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of samples.

8 Mechanical Drawing



PIN NO.	SYMBOL
1	GND
2	VDD
3	SCL
4	NC
5	SDA
6	NC
7	/RST
8	NC
9	INT
10	GND

NO.	PIN NAME
1	LED-K
2	LED-A
3	GND
4	SPI4W
5	D/I0
6	D/I1
7	D/I2
8	D/I3
9	D/I4
10	D/I5
11	D/I6
12	D/I7
13	D/I8
14	D/I9
15	D/I10
16	D/I11
17	TE
18	D/I12
19	D/I13
20	D/I14
21	D/I15
22	GND
23	RESET
24	WRX
25	SDA
26	CS
27	GND
28	RDX
29	DCX
30	GND
31	IM1
32	IM0
33	VDDIO
34	VDD
35	GND
36	NC
37	NC
38	NC
39	NC
40	NC

9 Precautions for Use of LCD Modules

Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

9.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

9.1.6 Do not attempt to disassemble the LCD Module.

9.1.7 If the logic circuit power is off, do not apply the input signals.

9.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

9.1.8.1 Be sure to ground the body when handling the LCD Modules.

9.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

9.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

9.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

Storage Precautions

9.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

9.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is: Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

9.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

Transportation Precautions

9.3.1 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.