

Approval sheet

Customer: _____
Model name: JT350MCHH-01P
Spec NO: _____
Date: 2015.10.6
Version: 01

- Preliminary Specification**
 Final Specification

For Customer's Acceptance

Approved by	Content

Approved by	Reviewed by	Prepared by

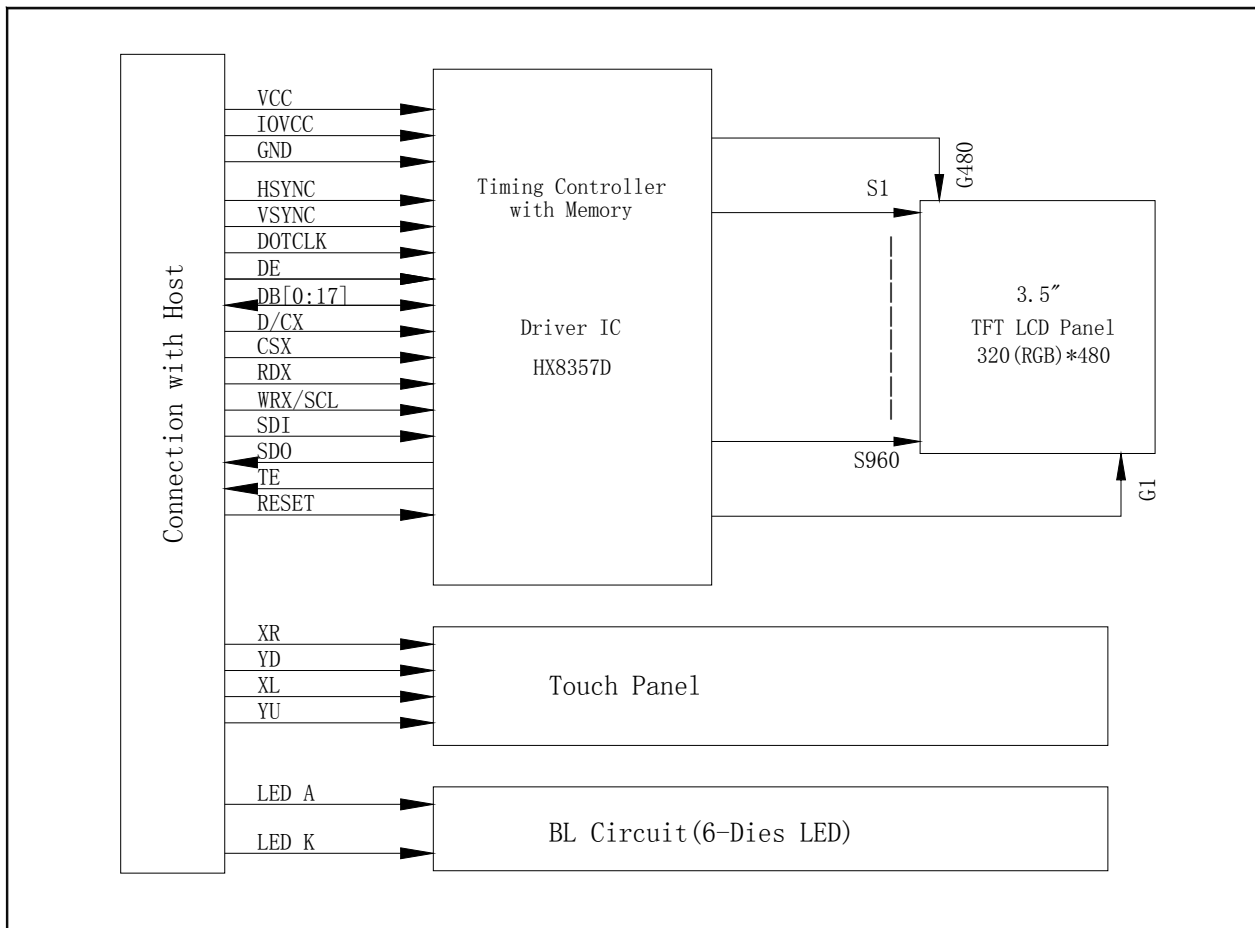
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1. General Specification

Item	Contents	Unit
LCD TYPE	TFT/TRANSMISSIVE	
MODULE SIZE (W*H*T)	54.66*82.94*3.45	MM
ACTIVE SIZE (W*H)	48.96*73.44	MM
PIXEL PITCH (W*H)	0.153*0.153	MM
NUMBER OF DOTS	320*480	
DIVER IC	HX8357D	
INTERFACE TYPE	SPI+18BIT RGB	
TOP POLARIZER TYPE	ANTI-GLARE	
RECOMMEND VIEWING DIRECTION	ALL	O'CLOCK
GRAY SCALE INVERSION DIRECTION	--	O'CLOCK
COLORS	262K	
BACKLIGHT TYPE	6-DIES WHITE LED	
TOUCH PANEL TYPE	Resistive TP	

3. Block Diagram



4. Interface Pin Function

Pin No.	Symbol	Description
1	GND	Power ground.
2	A	Anode of LED backlight.
3	A	Anode of LED backlight.
4	K	Cathode of LED backlight.
5	K	Cathode of LED backlight.
6	GND	Power ground.
7	GND	Power ground.
8	VCC	Power supply for analog voltage.
9	IOVCC	Power supply for logic voltage.
10	RESET	Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied.
11	VSYNC	Vertical synchronizing signal in RGB interface. If this pin is not used, connect it to GND.
12	HSYNC	Horizontal synchronizing signal in RGB interface. If this pin is not used, connect it to GND.
13	GND	Power ground.
14	DOTCLK	Data enable signal in RGB interface. If this pin is not used, connect it to GND.
15	GND	Power ground.
16	DE	A data ENABLE signal in RGB mode. If this pin is not used, connect it to GND.
17~34	DB17~DB0	Data bus.
35	SDO	Serial data output. If SDO_EN=0, SDO is not use. If SDO_EN=1, SDO is serial data output. If not used, please let it open.
36	SDI	Serial data input pin and output pin in serial bus system interface. The data is inputted on the rising edge of the SCL signal. If not used, please let it open.
37	RDX	MPU mode: Serves as a read signal and read data at the low level. If this pin is not used, connect it to IOVCC or GND.
38	WRX/SCL	MPU mode: Serves as a write signal and write data at the low level. SPI mode: it servers as SCL (Serial Clock) If this pin is not used, connect it to IOVCC or GND.
39	D/CX	MPU, SPI-4 line: Data / Command Selection pin. If this pin is not used, connect it to IOVCC or GND.
40	CSX	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed. If this pin is not used, connect it to IOVCC.

41	TE	Tearing effect output. If not used, please open this pin.
42	XR	Touch panel control PIN: XR
43	YD	Touch panel control PIN: YD
44	XL	Touch panel control PIN: XL
45	YU	Touch panel control PIN: YU

5. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for analog	VCC	-0.3	4.6	V
Supply voltage for logic	IOVCC	-0.3	4.6	V
Supply current (One LED)	I _{LED}		30	mA
Operating temperature	T _{OP}	-20	+70	°C
Storage temperature	T _{ST}	-30	+80	°C

6. Electrical Characteristics

6.1 Input Power

Item	Symbol	Min	Typ.	Max	Unit	Applicable terminal
Supply Voltage for Analog	VCC	2.5	2.8	3.3	V	
Supply Voltage for Logic	IOVCC	1.65	1.8/2.8	3.3	V	
Input Voltage	V _{IL}	GND	-	0.3IOVCC	V	
	V _{IH}	0.8 IOVCC	-	IOVCC		
Input leakage Current	I _{LKG}	-1		1	μA	

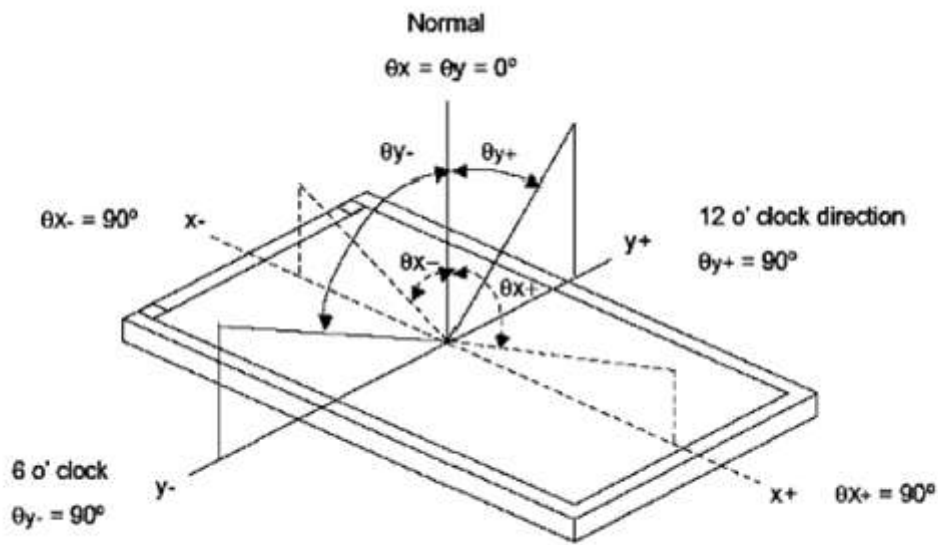
6.2 Backlight Driving Conditions

Item	Symbol	Value			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	V _F	18.0	19.2	20.4	V	I _L =20mA
Current for LED Backlight	I _L		20	30	mA	
Power Consumption	P		0.384		W	
LED Life Time		30,000			Hr	Note

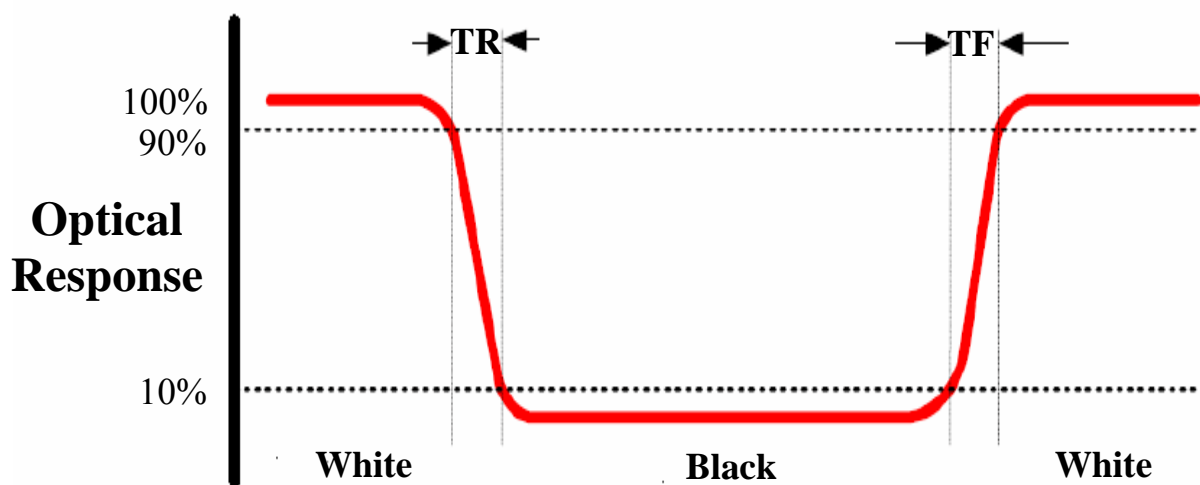
Note: Brightness to be decreased to 50% of the initial value at ambient temperature TA=25°C

7. Optical Characteristics

ITEM	SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE
			MIN	TYP.	MAX		
Luminance	L	$I_L = 20\text{mA}$		270		Cd/m^2	
Contrast Ratio	CR	$\theta = 0^\circ$		700			
Response Time	T_{ON}	25°C		30		ms	
	T_{OFF}						
CIE Color Coordinate	Red	X_R	Viewing normal angle				
		Y_R					
	Green	X_G					
		Y_G					
	Blue	X_B					
		Y_B					
	White	X_W			0.327		
		Y_W			0.354		
Viewing Angle	Hor.	θ_{x+}	$\text{CR} \geq 10$		80		Degree
		θ_{x-}			80		
	Ver.	θ_{y+}			80		
		θ_{y-}			80		
Uniformity	Un			80		%	

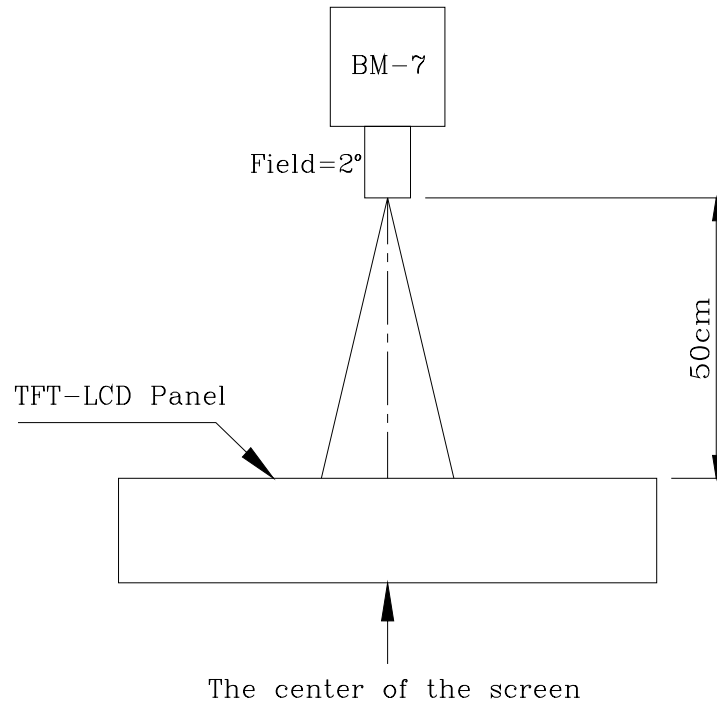
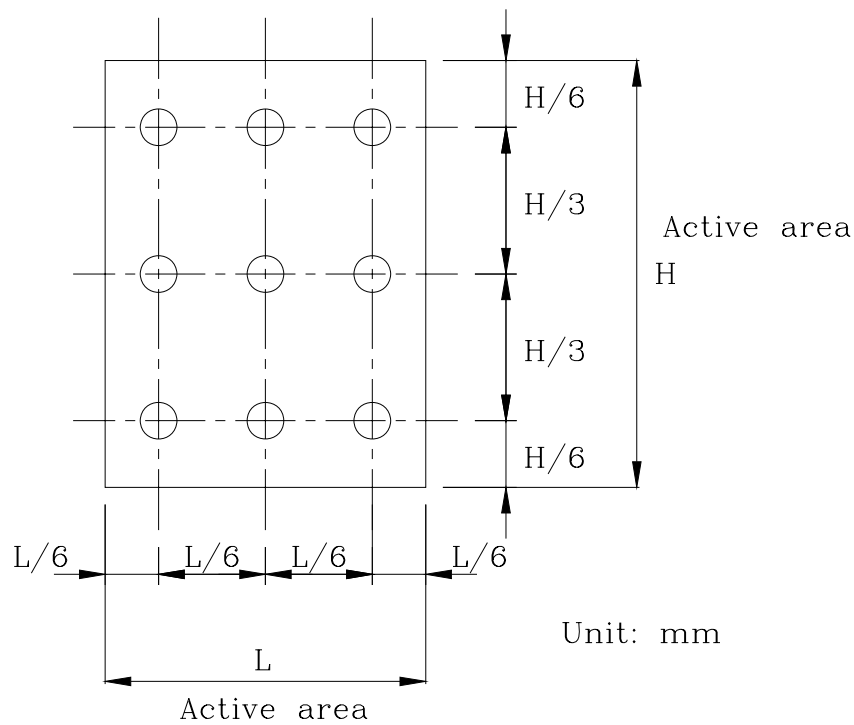
Note 1: Definition of Viewing Angle θ_x and θ_y :**Note 2: Definition of contrast ratio CR:**

$$CR = \frac{\text{Luminance of white state}}{\text{Luminance of black state}}$$

Note 3: Definition of Response Time (T_r, T_f)

Note 4: Definition of Luminance**① The Brightness Test Equipment Setup**

Field=2° (As measuring “black” image, field=2° is the best testing condition)

**② The Brightness Test Point Setup**

8. Timing Characteristics

8.1 MPU interface characteristic

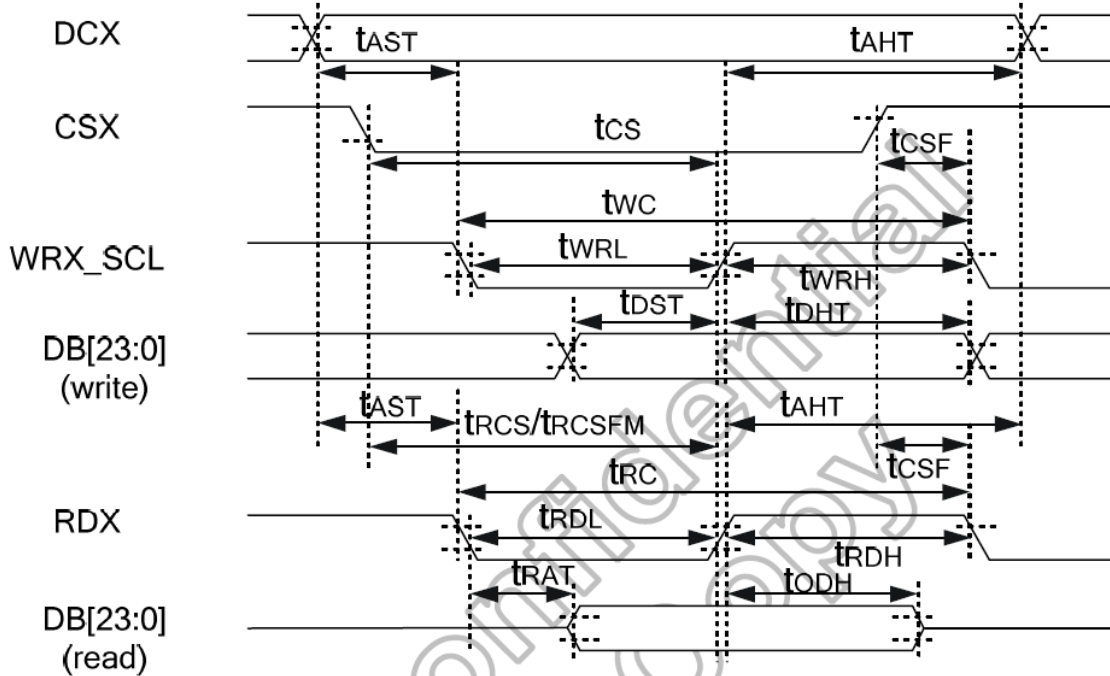


Figure 8.1:MPU interface characteristics

(GND=0V, IOVCC=1.8V, VCI=2.8V, TA=25°C, Sleep Out states)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX	tAST	Address setup time	0	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-	ns	-
CSX	tCS	Chip select setup time (Write)	10	-	ns	-
	tRCS	Chip select setup time (Read register)	45	-	ns	-
	tRCSEFM	Chip select setup time (GRAM)	355	-	ns	-
	tCSF	Chip select wait time (Write/Read)	10	-	ns	-
WRX_SCL	tWC	Write cycle (write register)	50	-	ns	-
	tWC	Write cycle (write GRAM@SLPOUT)	47	-	ns	-
	tWC	Write cycle (write GRAM@SLPIN)	100	-	ns	-
	tWRH	Control pulse "H" duration	15	-	ns	-
	tWRL	Control pulse "L" duration	15	-	ns	-
RDX	tRC	Read cycle (read register)	160	-	ns	-
	tRC	Read cycle (GRAM)	450	-	ns	-
	tRDH	Control pulse "H" duration	90	-	ns	-
	tRDL	Control pulse "L" duration(read register)	35	-	ns	-
	tRDL	Control pulse "L" duration(GRAM)	345	-	ns	-
DB[23:0]	tDST	Data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10	-	ns	
	tRAT	Read access time(read register)	-	40	ns	
	tRAT	Read access time(GRAM)	-	340	ns	
	tODH	Output disable time	20	80	ns	

Table 8.1: MPU interface characteristics

Note: 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 30% and 70% of IOVCC for Input signals.

8.2 SPI interface characteristics

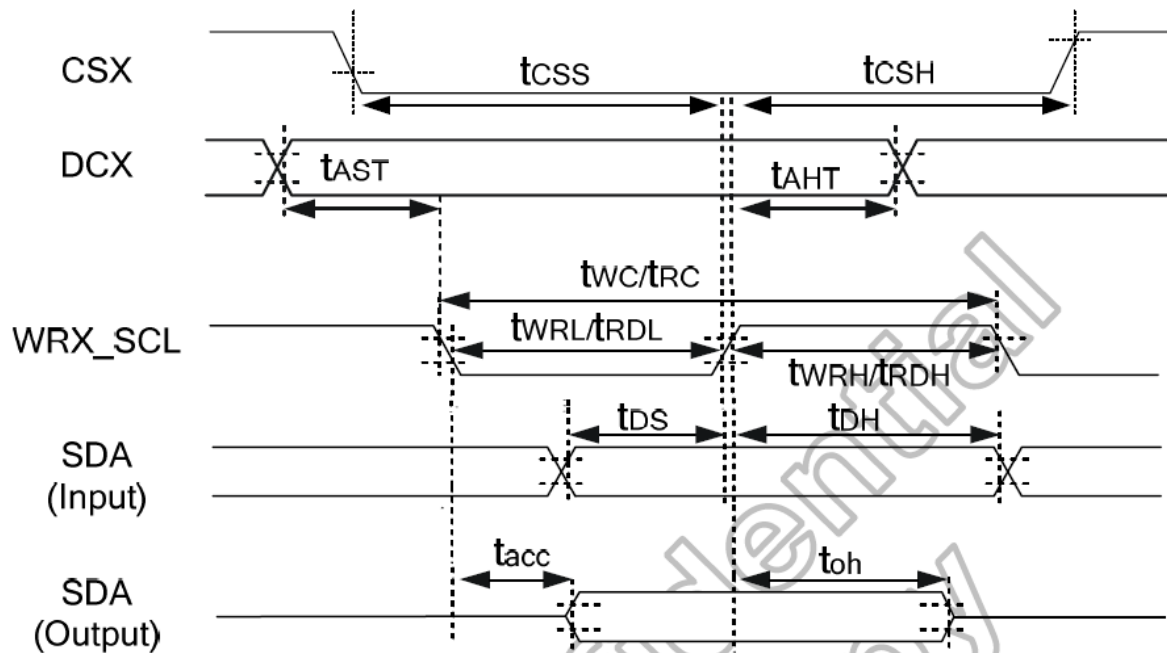


Figure 8.2: SPI interface characteristics

(GND=0V, IOVCC=1.8V, VCI=2.8V, $T_A=25^\circ\text{C}$, Sleep Out states)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	t_{CSS}	Chip select setup time (Write)	15	-	ns	-
	t_{CSS}	Chip select setup time (Read)	60	-		
	t_{CSh}	Chip select hold time (Write)	15	-		
	t_{CSh}	Chip select hold time (Read)	65	-		
DCX	t_{AST}	Address setup time	0	-	ns	-
	I	Address hold time (Write/Read)	10	-		
WRX_SCL (Write)	t_{WC}	Write cycle	66	-	ns	-
	t_{WRH}	Control pulse "H" duration	15	-		
	t_{WRL}	Control pulse "L" duration	15	-		
WRX_SCL (Read)	t_{RC}	Read cycle	150	-	ns	-
	t_{RDH}	Control pulse "H" duration	60	-		
	t_{RDL}	Control pulse "L" duration	60	-		
SDA (Input)	t_{DS}	Data setup time	10	-	ns	For maximum $C_L=30\text{pF}$
	t_{DH}	Data hold time	10	-		
SDA (Output)	t_{ACC}	Read access time	10	50	ns	For minimum $C_L=8\text{pF}$
	t_{OH}	Output disable time	15	50		

Table 8.2: SPI interface characteristics

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

8.3 RGB interface characteristics

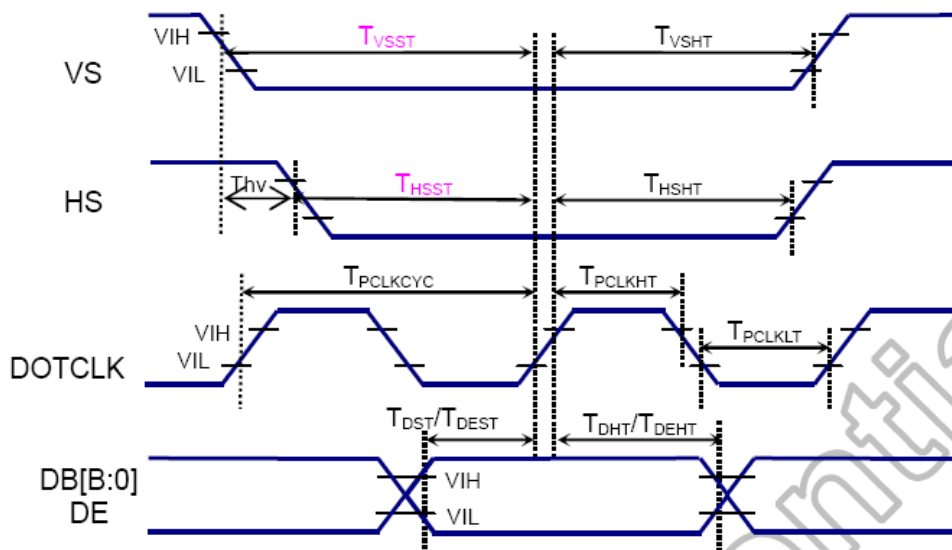


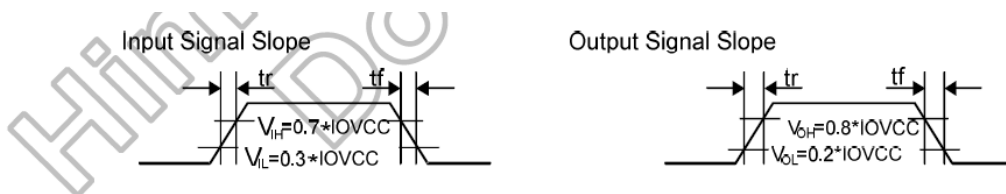
Figure 8.3: RGB interface characteristics

(GND=0V, IOVCC=1.8V, VCI=2.8V, TA=25°C, Sleep Out states)

Item	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
Pixel low pulse width	T _{CLKLT}	-	15	-	-	ns
Pixel high pulse width	T _{CLKHT}	-	15	-	-	ns
Vertical Sync. Set-up time	T _{VSST}	-	15	-	-	ns
Vertical Sync. Hold time	T _{VSHT}	-	15	-	-	ns
Horizontal Sync. Set-up time	T _{HSST}	-	15	-	-	ns
Horizontal Sync. Hold time	T _{HSHT}	-	15	-	-	ns
Data Enable set-up time	T _{DEST}	-	15	-	-	ns
Data Enable hold time	T _{DEHT}	-	15	-	-	ns
Data set-up time	T _{DST}	-	15	-	-	ns
Data hold time	T _{DHT}	-	15	-	-	ns
Phase difference of sync signal falling edge	Thv	-	0	-	320	Dotclk

Table 8.3: RGB interface characteristics

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.



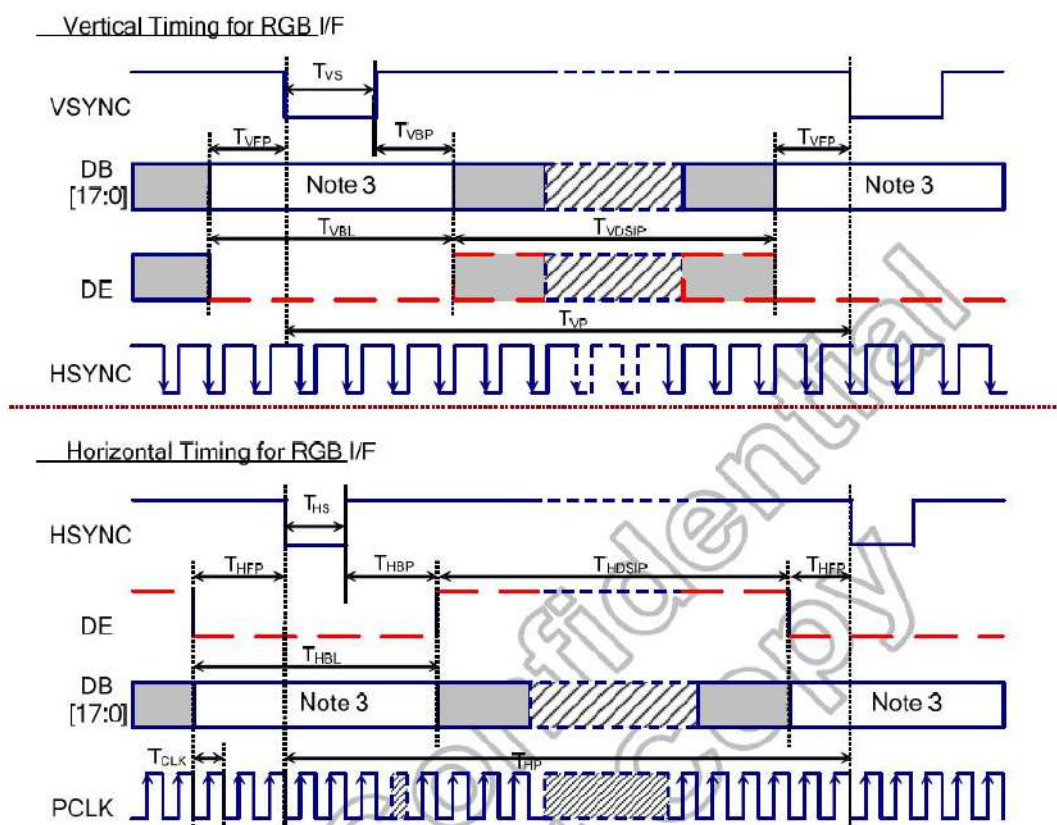


Figure 8.4: General timings for RGB I/F-2

Item	Symbol	Condition	Specification			Unit
			Min.	Typ.	Max.	
Vertical Timing						
Vertical cycle period	T_{VP}	-	486	-	-	HS
Vertical low pulse width	T_{VS}	-	2	-	-	HS
Vertical front porch	T_{VFP}	-	2	-	-	HS
Vertical back porch	T_{VBP}	-	2	-	-	HS
Vertical blanking period	T_{VBL}	$T_{VS} + T_{VBP} + T_{VFP}$	6	-	-	HS
Vertical active area	T_{VDISP}	-	-	480	-	HS
			-		-	HS
			-		-	HS
Vertical refresh rate	T_{VRR}	Frame rate	50	60	70	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}	-	335	-	-	DOTCLK
Horizontal low pulse width	T_{HS}	-	5	-	-	DOTCLK
Horizontal front porch	T_{HFP}	-	5	-	-	DOTCLK
Horizontal back porch	T_{HBP}	-	5	-	-	DOTCLK
Horizontal blanking period	T_{HBL}	$T_{HS} + T_{HBP} + T_{HFP}$	15	-	-	DOTCLK
Horizontal active area	T_{HDISP}	-	-	320	-	DOTCLK
Pixel clock cycle	f_{CLKCYC}	-	9	-	-	MHz
TVRR=60Hz						

Table 8.4: RGB interface characteristics-2

- Note:** (1) IOVCC=1.65 to 3.3V, VCI=2.3 to 3.3V, VSSA=VSSD=0V, Ta=-30 to 70°C (to +85°C no damage)
 (2) Data lines can be set to "High" or "Low" during blanking time – Don't care.
 (3) HP is multiples of PCLK.

8.4 Reset input timing

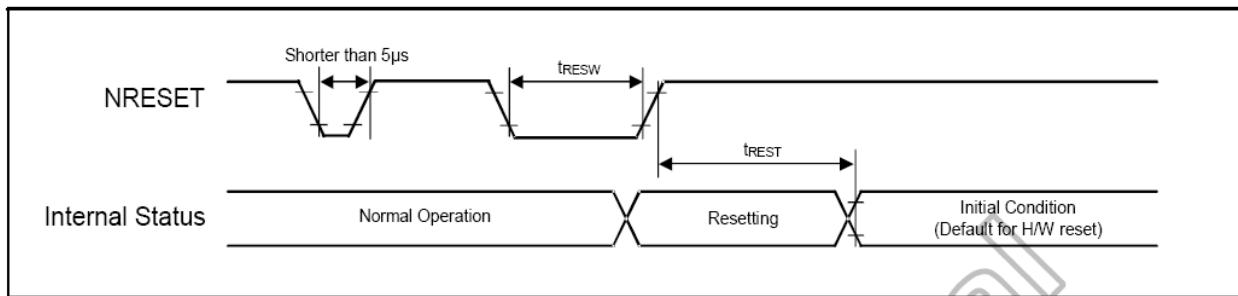


Figure 8.5: Reset input timing

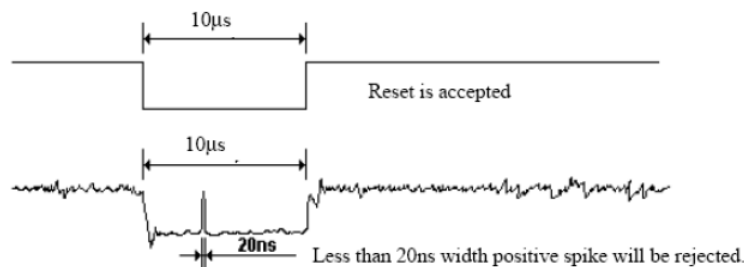
Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width ⁽¹⁾	NRESET	10	-	-	-	µs
tREST	Reset complete time ⁽²⁾	-	5	-	-	When reset applied during SLPIN mode	ms
		-	120	-	-	When reset applied during SLPOUT mode	ms

Table 8.5: Reset input timing

Note: (1) Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the following table.

NRESET Pulse	Action
Shorter than 5 µs	Reset Rejected
Longer than 10 µs	Reset
Between 5 µs and 10 µs	Reset Start

- (2) 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 H/W reset.
- (3) During Reset Complete Time, ID and VCOM value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of NRESET.
- (4) Spike Rejection also applies during a valid reset pulse as shown as below:



01. It is necessary to wait 5msec after releasing NRESET before sending commands. Also Sleep Out command cannot be sent for 120msec.

9. Standard Specification for Reliability

9.1 Standard Specification for Reliability of LCD Module

No.	Item	Description
01	High temperature operation	The sample should be allowed to stand at 70°C for 120 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
02	Low temperature operation	The sample should be allowed to stand at -20°C for 120 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
03	High temperature storage	The sample should be allowed to stand at 80°C for 240 hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 2 hours.
04	Low temperature storage	The sample should be allowed to stand at -30°C for 240 hours under no-load condition, then returning it to normal temperature condition, and allowing it stand for 2 hours.
05	Moisture storage	The sample should be allowed to stand at 60°C,90%RH MAX for 240 hours under no-load condition, then taking it out and drying it at normal temperature for 2 hours.
06	Thermal shock storage	The sample should be allowed to stand the following 10 cycles : -30°C for 30 minutes → normal temperature for 5 minutes → +80°C for 30 minutes → normal temperature for 5 minutes, as one cycle.
07	Packing vibration	Frequency range : 10Hz ~ 55Hz Amplitude of vibration : 1.5mm Sweep time: 12 min X,Y,Z 2 hours for each direction.
08	Packing drop test	According to ASTM-D-5327.
09	Electrical Static Discharge	Air: ±4KV 150pF/330Ω 5 times
		Contact: ±2KV 150pF/330Ω 5 time

*Sample size for each test item is 3~5pcs

9.2 Testing Conditions and Inspection Criteria

For the final test, the testing sample must be stored at room temperature for 24 hours. After the tests listed in Table 9.2, standard specifications for reliability will be executed in order to ensure stability.

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

9.3 MTBF

MTBF	Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature ($25\pm 5^{\circ}\text{C}$), normal humidity ($50\pm 10\%$ RH), and in area not exposed to direct sun light.
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10. Specification of Quality Assurance

This standard of Quality Assurance confirms to the quality of LCD module products supplied by us.

10.1 Quality Test

Before delivering, the supplier should conduct the following tests to confirm the quality of products.

- Electrical-Optical Characteristics: According to the individual specification to test the product.
- Appearance Characteristics: According to the individual specification to test the product.
- Reliability Characteristics: According to the definition of reliability on the specification for testing products.

10.2 Delivery Test

Before delivering, the supplier should conduct the delivery test.

- Test method: According to MIL-STD105E.General Inspection Level II take a single Time.
- The defects classify of AQL as following:
Major defect: AQL = 0.65
Minor defect: AQL = 2.5
Total defects: AQL = 2.5

10.3 Non-conforming Analysis & Deal With Manners

10.3.1 Non-conforming Analysis

- Purchaser should provide the data detail of non-conforming sample and the non-conforming.
- After receiving the data detail from purchaser, the analysis of non-conforming should be finished within two weeks.
- If the analysis can't be finished on time, supplier must notice purchaser 3 days in advance.

10.3.2 Disposition of non-conforming

- If any product defect be found during assembling, supplier must change the good for every defect after confirmation.
- Both supplier and customer should analyze the reason and discuss the disposition of non-conforming when the reason of nonconforming is not sure.

10.4 Agreement items

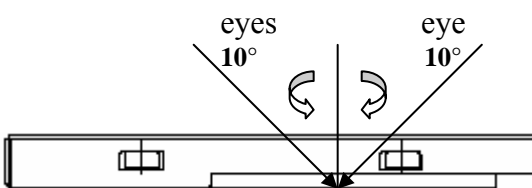
Both parties should negotiate together when the following problems happen.

- There is any problem of standard of quality assurance, and both sides should agree that it must be modified.
- There is any argument item which does not record in the standard of quality assurance.
- Any other special problem.

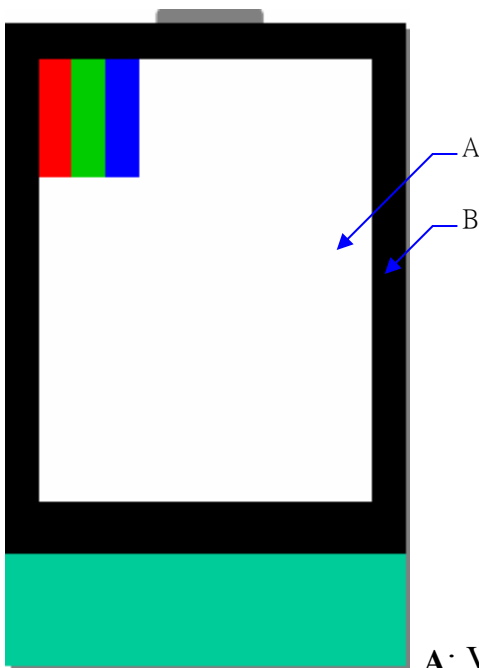
10.5 Standard of The Product Appearance Test

10.5.1 Manner of appearance test

- The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.
- When test the model of transmissive product must add the reflective plate.
- The test direction is base on around 10° of vertical line.
- Temperature: 25±5°C Humidity: 60±10%RH



- Definition of area:



A: Viewing area B: Outside viewing area

10.5.2 Basic principle

- When the standard can not be described, AQL will be applied.
- The sample of the lowest acceptable quality level must be negotiated by both supplier and customer when any dispute happened.
- New item must be added on time when it is necessary.

11. Handling Precaution

11.1 Handling of LCM

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

11.2 Storage

- Store it in an ambient temperature of $25\pm 10^{\circ}\text{C}$, and in a relative humidity of $50\pm 10\%\text{RH}$. Don't expose to sunlight or fluorescent light.
- Store it in a clean environment, free from dust, active gas, and solvent.
- Store it in anti-static electricity container.
- Store it without any physical load.

11.3 Soldering

- Use only soldering irons with proper grounding and no leakage.
- Iron: no higher than $280\pm 10^{\circ}\text{C}$ and less than 3 sec during hand soldering.
- Rewiring: no more than 2 times.

12. Packing Method

----TBD