2.8 inch TFT LCD
Without Touch Panel
SPECIFICATION

MODEL NAME: LMCY2028BQN3

Date: 2014 / 02 / 05

Customer signature		
Customer		
Approved date	**Approved by**	**Reviewed by**

1. Revision History

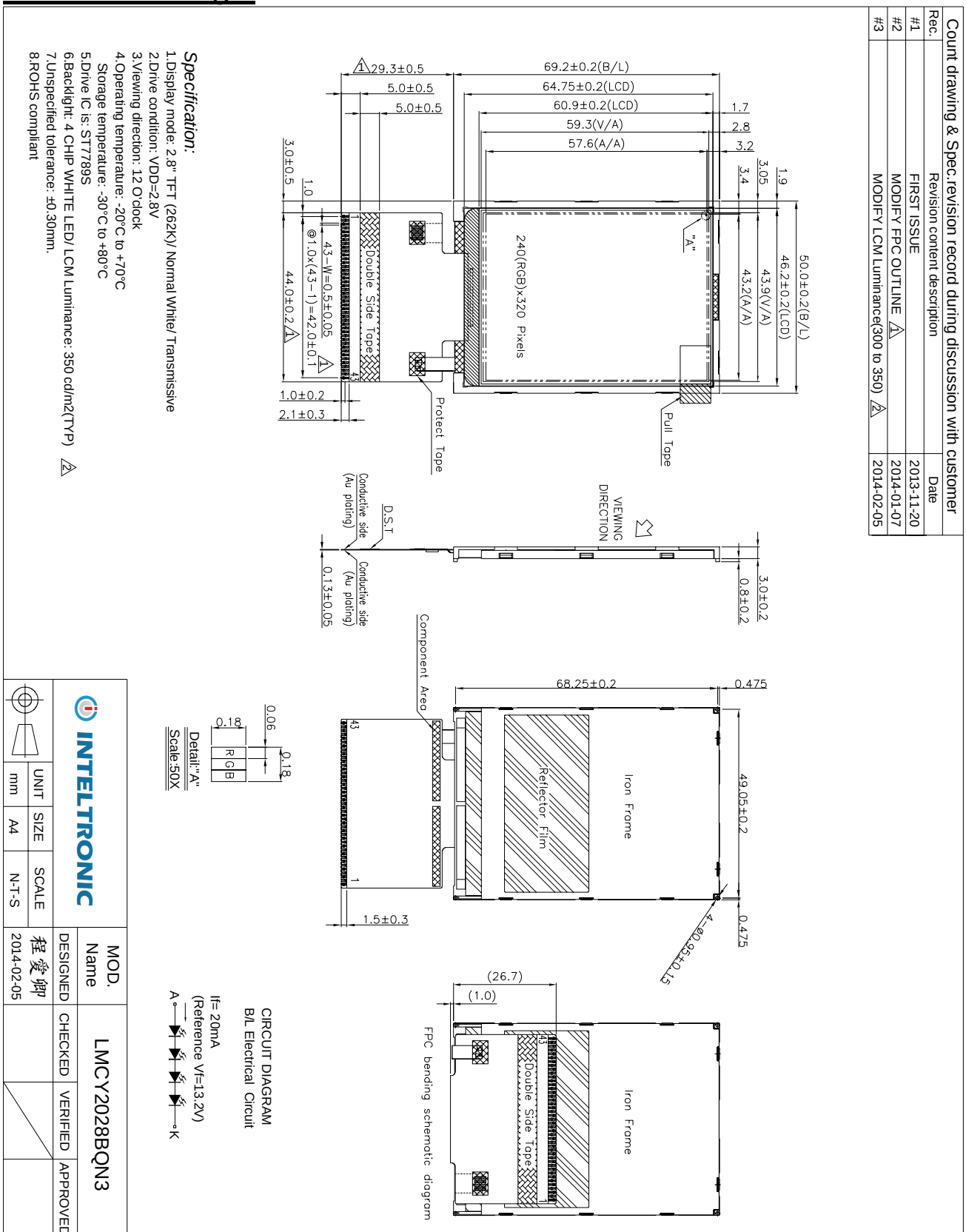
Sample Version	DOC. Version	DATE	DESCRIPTION		CHANGED BY
A0	00	2013-11-22	SPEC ONLY	First issue	Gavin/Aiching
A0	01	2014-01-07	SPEC ONLY	Modify: 1.LCM drawing (P.5) 2.Pin Assignment (P.13) 3.Block Diagram (P.15)	Gavin/Aiching
A0	02	2014-02-05	FULL SPEC	First Sample Modify LCM Luminance(300 to 350)	Gavin/Aiching

2. Table of Contents:

3. General Specification:

ITEM	CONTENTS
Module Size	50.0(W) * 69.2(H) * 3.0(T) mm
Module Size(With FPC)	50.0(W) * 98.5(H) * 3.0(T) mm
Display Size(Diagonal)	2.8 inch
Display Format	240(RGB) * 320 Pixels
Active Area	43.2(W) * 57.6(H) mm
Pixel Pitch	0.18 * 0.18 mm
LCD Type	TFT(262K) / Transmissive/NW
View Angle	12 O'clock
Controller IC	ST7789S
Weight	17.3g

4. LCM drawing:



5. Electrical Characteristics

5-1 Absolute Maximum Ratings (Ta=25℃ VSS=0V)

Item	Symbol	Min.	Type	Max.	Unit	Remark
Supply Voltage	V_{DD}	-0.3	-	+4.6	V	Note1
Supply Voltage(Logic)	V_{DDI}	-0.3		+4.6		Note1
Logic Input Voltage Range	V_{IN}	0.5		$V_{DDI+0.5}$	V	Note1
Operating Temperature	Topr	-20	-	+70	℃	-
Storage Temperature	Tstg	-30	-	+80	℃	-

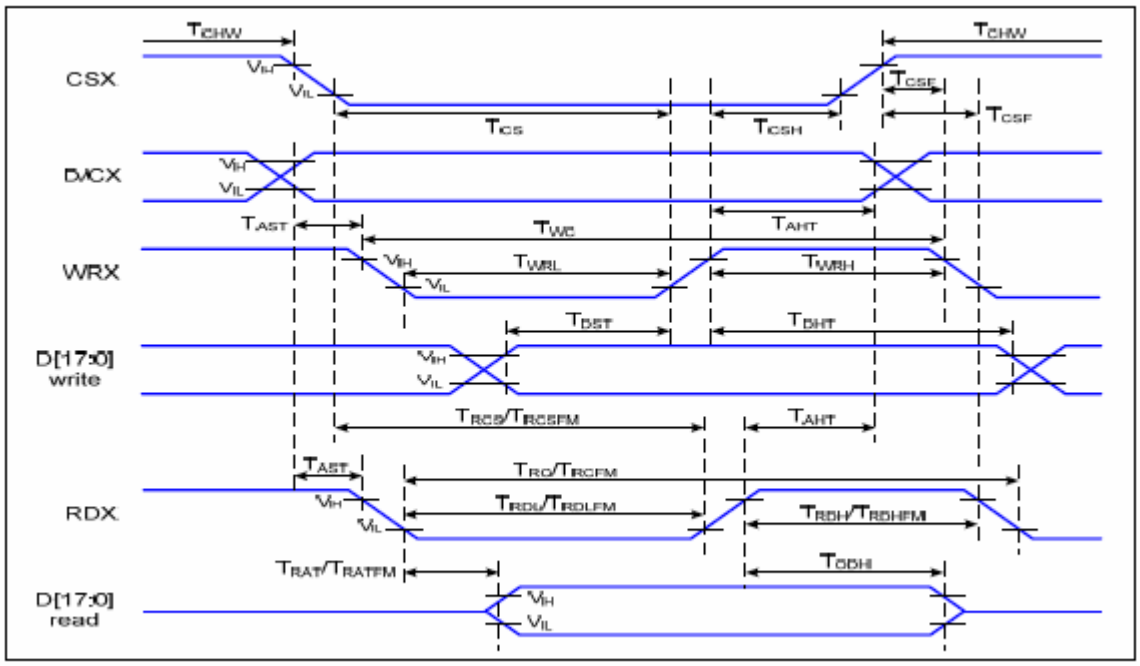
Note1: Absolute maximum rating is the limit value beyond which the IC maybe broken. They do not assure operations.

5-2 Operating Conditions (Ta=25℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply voltage	V_{DD}	-	2.6	2.8	3.0	Volt
Input Voltage	V_{IH}	-	0.7 * V_{DDI}	-	V_{DDI}	V
	V_{IL}	-	V_{SS}	-	0.3* V_{DDI}	V
Power Supply Current for LCM	I_{DD}	V_{DD}=2.8V	-	6.7	10.1	mA

5-3 Timing Characteristics

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

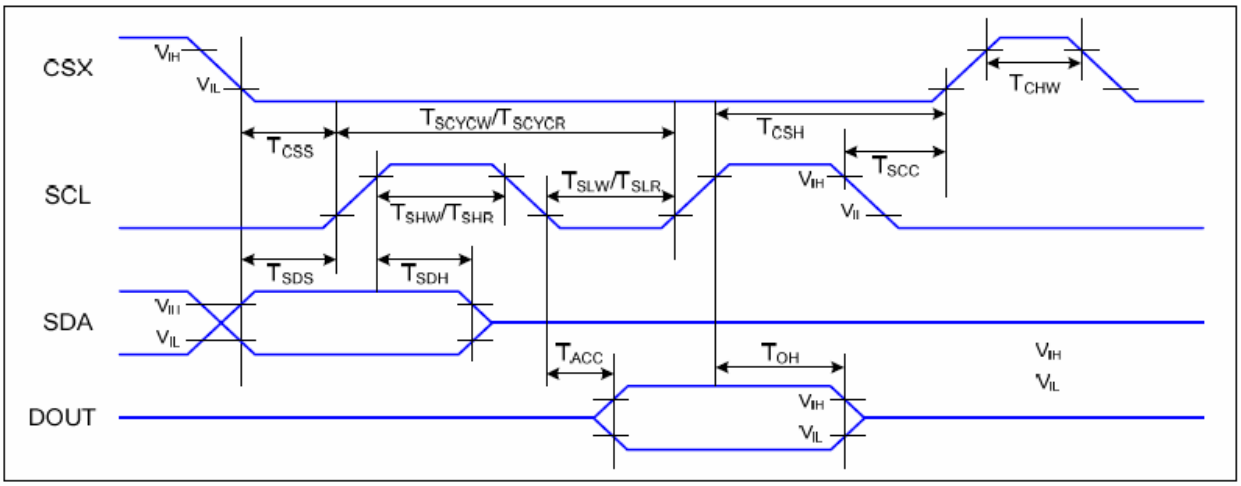


Parallel Interface Timing Characteristics (8080-Series MCU Interface)

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

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

Serial Interface Characteristics (3-line serial):



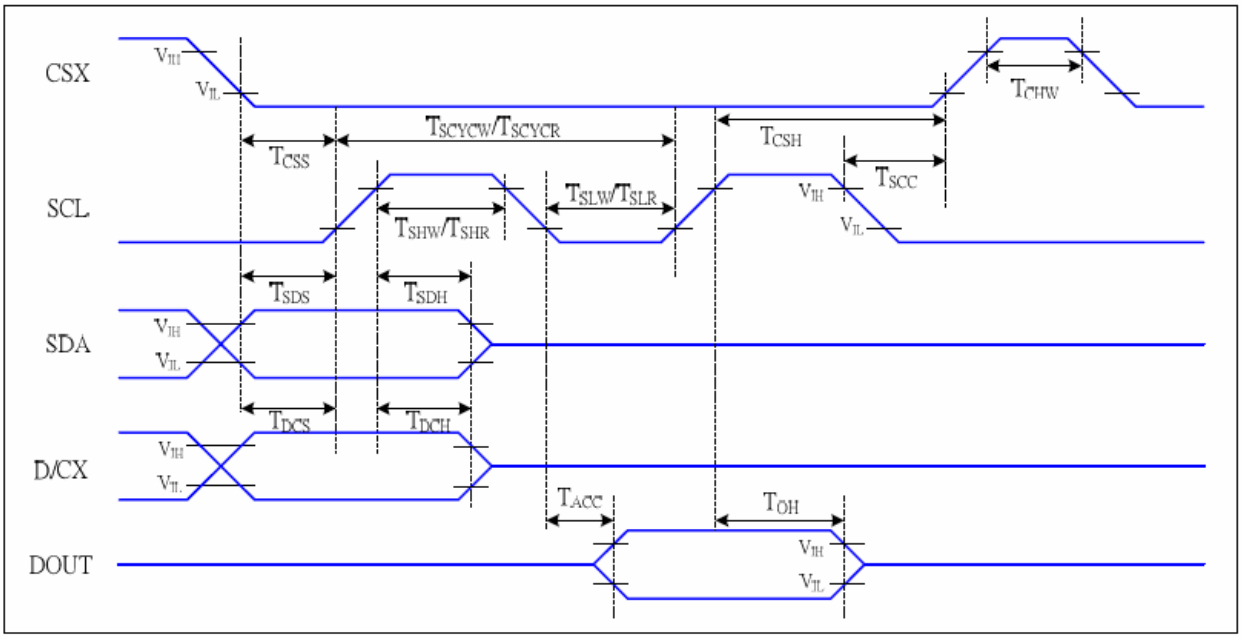
3-line serial Interface Timing Characteristics

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

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

3-line serial Interface Characteristics

Serial Interface Characteristics (4-line serial):



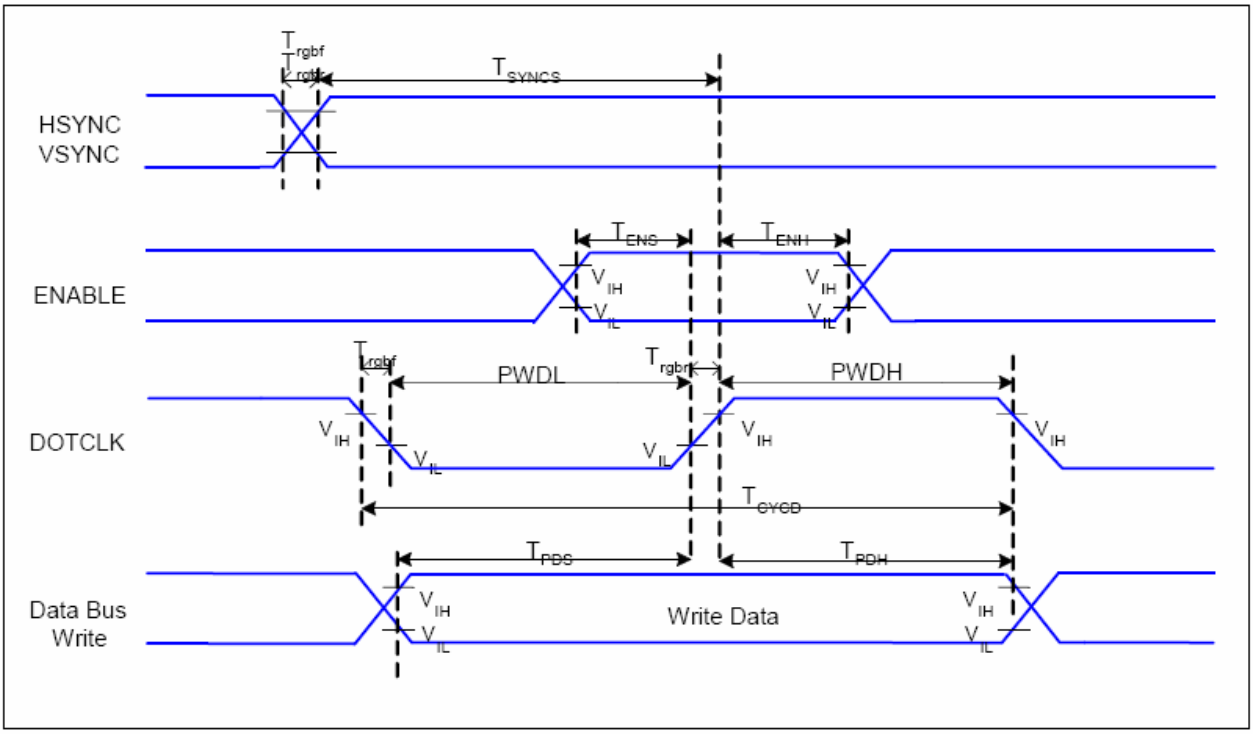
4-line serial Interface Timing Characteristics

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

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

4-line serial Interface Characteristics

RGB Interface Characteristics:



RGB Interface Timing Characteristics

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

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	30	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	25	-	ns	
	T_{ENH}	Enable Hold Time	25	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	60	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	120	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	20	ns	
DB	T_{PDS}	PD Data Setup Time	50	-	ns	
	T_{PDH}	PD Data Hold Time	50	-	ns	

18/16 Bits RGB Interface Timing Characteristics

6. Optical Characteristics:

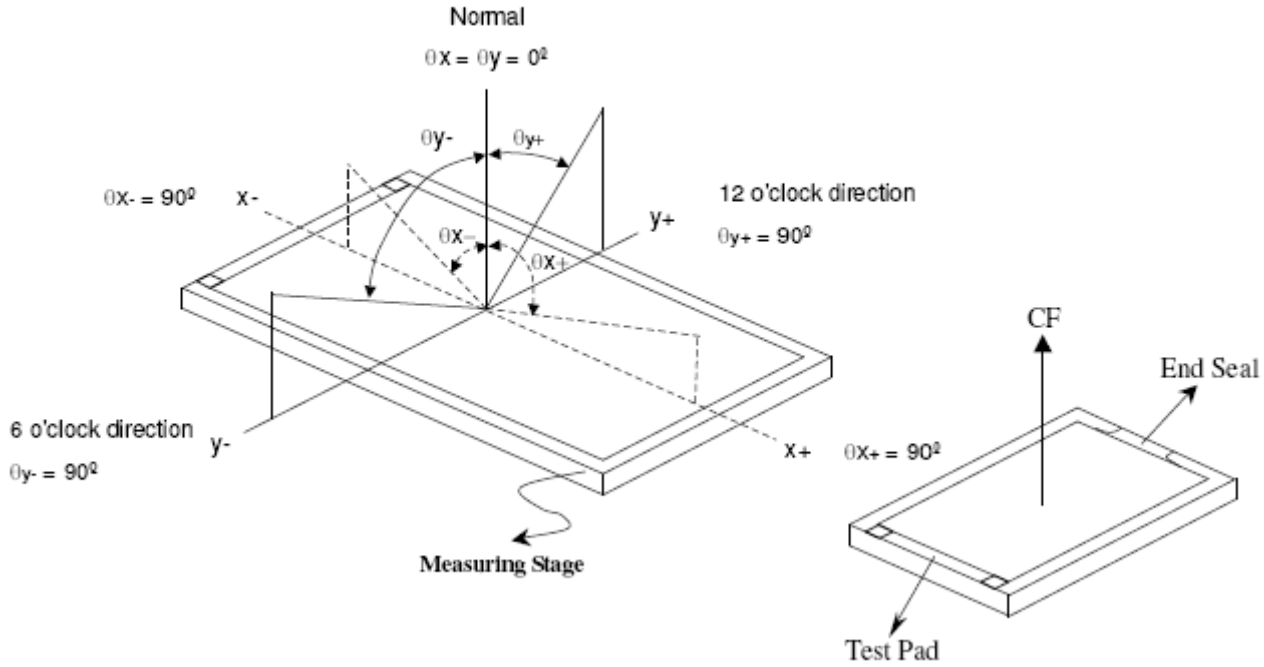
Item		Symbol	Conditions	Specifications			Unit	Note
				Min	Typ	Max		
Transmittance (With PL)		T(%)	−	-	6.13	-	-	-
Contrast Ratio		CR	Θ=0 Normal Viewing angle	-	500	-		(1) (2)
Response time		TR+TF	−	-	16	-	ms	(1) (3)
Viewing angle	Hor.	Θx+	CR≧10	-	70	-	deg.	-
		Θx-		-	70	-		
	Ver.	Θy+		-	70	-		
		Θy-		-	60	-		

Measuring Condition
1. Measuring surrounding: dark room
2. Ambient temperature: 25±2℃
3. 30 min. Warm-up time.

Color of CIE Coordinate:

Item		Symbol	Condition	Min.	Typ.	Max.	Brightness
Chromaticity Coordinates (Transmissive)	Red	x	θ = ϕ = 0° LED Backlight Color Degree x=0.29 y=0.29 Brightness =6500 cd/m²	0.611	0.626	0.641	80
		y		0.321	0.336	0.351	
	Green	x		0.261	0.276	0.291	240
		y		0.535	0.550	0.565	
	Blue	x		0.129	0.144	0.159	45
		y		0.115	0.130	0.145	
	White	x		0.292	0.307	0.322	350
		y		0.314	0.329	0.344	

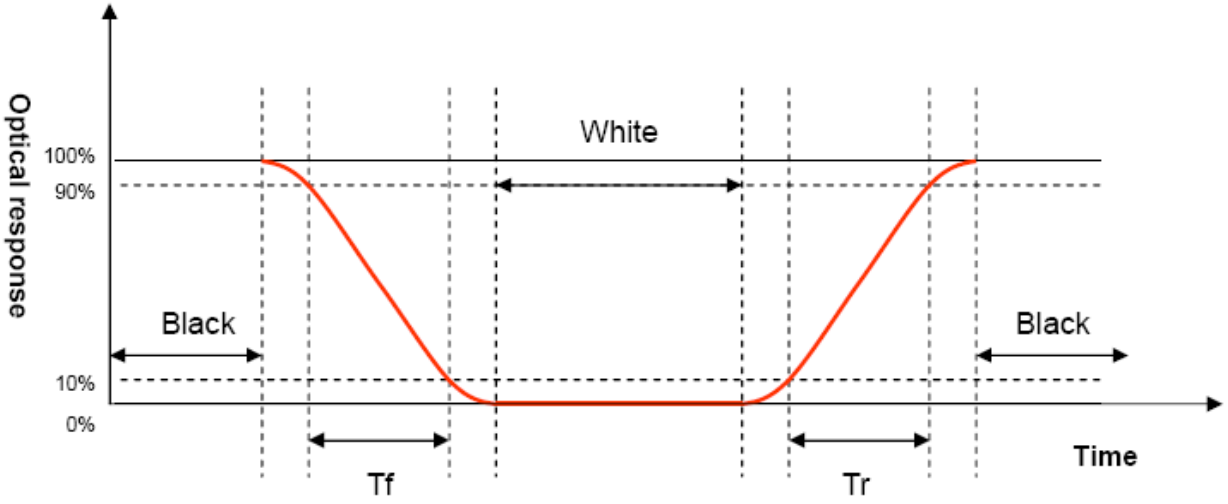
Note (1) Definition of Viewing Angle :



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

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black}}$$

Note (3) Definition of Response Time : Sum of TR and TF



7. Interface Pin Assignment:

No.	Symbol	Function
1	NC(YU)	Open.
2	NC(XL)	Open.
3	NC(YD)	Open.
4	NC(XR)	Open.
5	GND	Power Ground.
6	VDDI	Power Supply for I/O System.
7	SDO	SPI interface output pin.
8	DB17	-DB[17:0] are used as MCU parallel interface data bus. 8-bit I/F: when IM3:0, DB[7:0] are used; when IM3:1, DB[17:10] are used. 9-bit I/F: when IM3:0, DB[8:0] are used; when IM3:1, DB[17:9] are used. 16-bit I/F: when IM3:0, DB[15:0] are used; when IM3:1, DB[17:10] and DB[8:1] are used. 18-bit I/F: DB[17:0] are used. -DB[17:0] are used as RGB interface data bus. 6-bit RGB I/F: DB[5:0] are used. 16-bit RGB I/F: DB[15:0] are used. 18-bit RGB I/F: DB[17:0] are used. -If not used, please fix this pin at VDDI or DGND.
9	DB16	
10	DB15	
11	DB14	
12	DB13	
13	DB12	
14	DB11	
15	DB10	
16	DB9	
17	DB8	
18	DB7	
19	DB6	
20	DB5	
21	DB4	
22	DB3	
23	DB2	
24	DB1	
25	DB0	
26	SDA	-When IM3: Low, SPI interface input/output pin. -When IM3: High, SPI interface input pin.
27	DOTCLK	Dot clock signal for RGB interface operation.

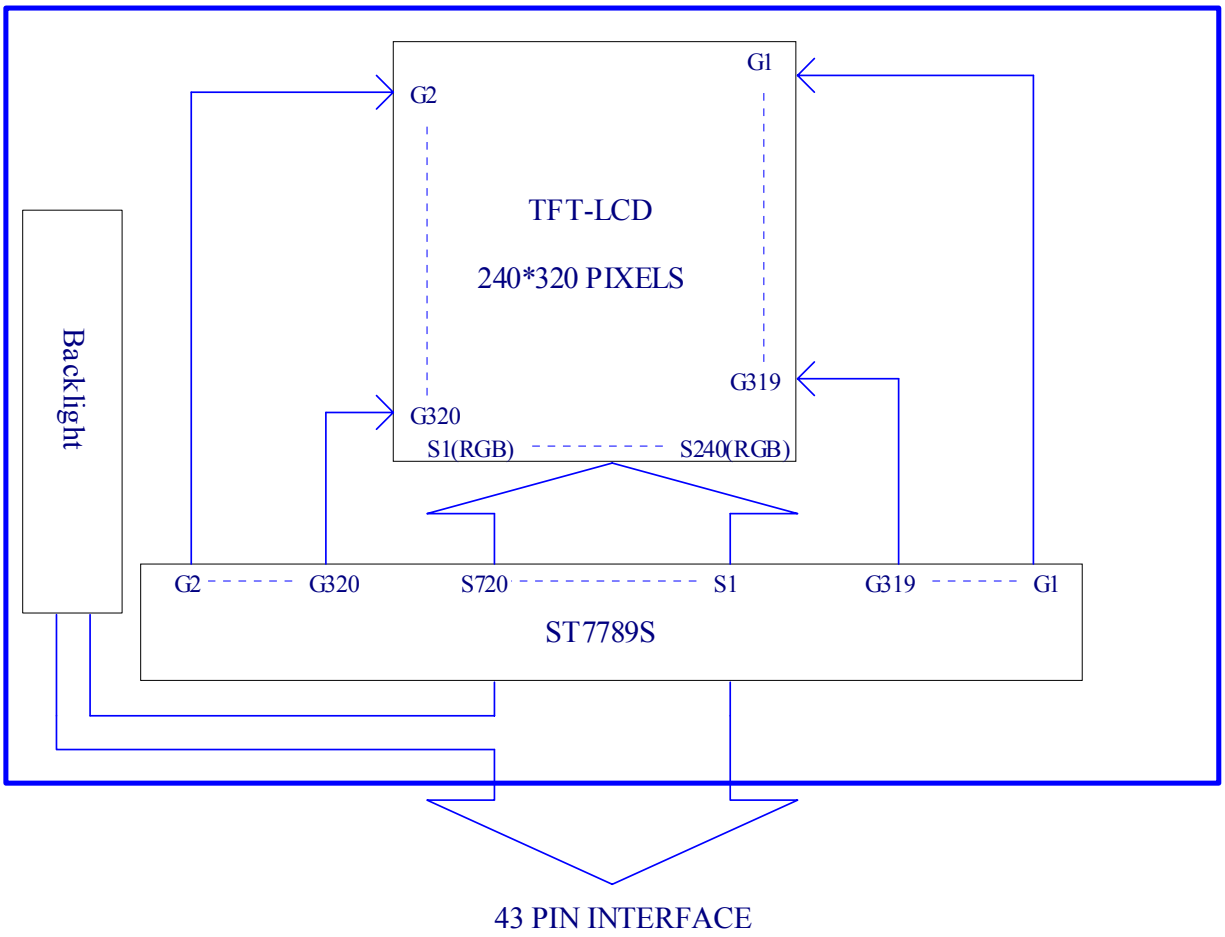
28	ENABLE	Data enable signal for RGB interface operation.
29	HSYNC	Horizontal (Line) synchronizing input signal for RGB interface operation.
30	VSYNC	Vertical (Frame) synchronizing input signal for RGB interface operation.
31	RDX	Read enable in 8080 MCU parallel interface.
32	WRX	Write enable in MCU parallel interface.
33	DCX	Display data/command selection pin in parallel interface.
34	CSX	Chip selection pin.
35	RESX	This signal will reset the device and it must be applied to properly initialize the chip.
36	IM0	The MCU interface mode select. Note1
37	IM1	
38	IM2	
39	IM3	
40	VDD	Power Supply for Analog, Digital System and Booster Circuit.
41	GND	Power Ground.
42	LED- (K)	Cathode of LED Backlight.
43	LED+ (A)	Anode of LED Backlight.

Note 1:

IM3	IM2	IM1	IM0	Interface	Read Back Data Bus Selection
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
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

Interface Type Selection

8. Block Diagram:



9. Backlight:

1. Standard Lamp Styles (Edge Lighting Type):
The LED chips are distributed over the edge light area of the illumination unit, which gives the less power consumption:

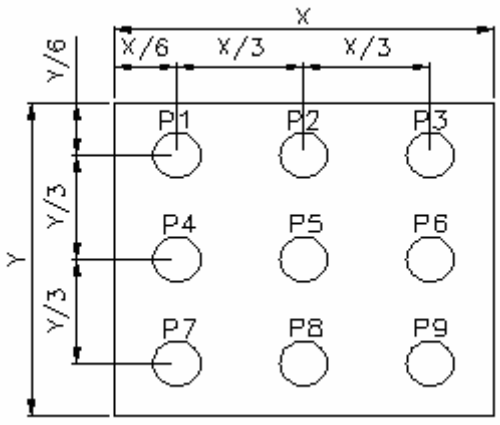
2. The Main Advantages of the LED Backlight are as following:
2.1 The brightness of the backlight can simply be adjusted.
By a resistor or a potentiometer.

3. Data About LED Backlight:

PARAMETER	Sym.	Min.	Typ.	Max.	Unit	Test Condition	Note
Supply Current	I	-	20	-	mA	V=13.2V	
Supply Voltage	V	12.0	13.2	13.6	V	If=20mA	
Reverse Voltage	VR	-	0.8	-	V	-	
Luminous Intensity for LCM	IV	250	350	-	cd/m^2	If=20mA	2
Uniformity for LCM	-	70	-	-	%	If=20mA	3
Life Time	-	20000	-	-	Hr.	If=20mA	4
Color	White						

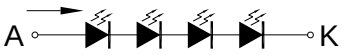
NOTE:
1. Backlight Only
2. Average Luminous Intensity of P1-P9
3. Uniformity = Min/Max * 100%
4. LED life time defined as follows: The final brightness is at 70% of original brightness

Measured Method: (X*Y: Light Area)



Internal Circuit Diagram

If= 20mA
(Reference Vf=13.2V)



(Effective spatial Distribution)
Hole Diameter ø3 mm; 1 to 9 per Position Measured Luminous

10. Standard Specification for Reliability:

10–1. Standard Specifications for Reliability of LCD Module

No	Item	Description
01	High temperature operation	The sample should be allowed to stand at 70℃ 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℃ 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℃ 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℃ 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℃,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℃ for 30 minutes → normal temperature for 5 minutes → +80℃ 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 ISTA 1A 2001.
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

10 - 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 10.2, Standard specifications for Reliability have been 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.

10- 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±5℃), normal humidity (50±10% RH), and in area not exposed to direct sun light.

11. Handling Precaution:

11-1 Handling of LCM

- Don't give external shock.
- Don't apply excessive force on the surface.
- Liquid in LCD is hazardous substance. Must not lick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.
- Don't operate it above the absolute maximum rating.
- Don't disassemble the LCM.
- The operators should be grounded 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 care when peeling off this protective film since static electricity may be generated.

11-2 Storage

- Store in an ambient temperature of 25±10℃, and in a relative humidity of 50±10%RH. Don't expose to sunlight or fluorescent light.
- Storage in a clean environment, free from dust, active gas, and solvent.
- Store in anti-static electricity container.
- Store without any physical load.

11-3 Soldering

- Use only soldering irons with proper grounding and no leakage.
- Iron: No higher than 280±10℃ and less than 3 sec during Hand soldering.
- Rewiring: no more than 2 times.

12. Inspection Specifications

The buyer (customer) shall inspect the modules within twenty calendar days since the delivery date (the "inspection period") at its own cost. The results of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to the seller.

The buyer may, under commercially reasonable reject procedures, reject an entire lot in the delivery involved if, within the inspection period, such samples of modules within such lot show an unacceptable number of defects in accordance with this incoming inspection standards, provided however that the buyer must notify the seller in writing of any such rejection promptly, and not later than within three business days of the end of the inspection period.

Should the buyer fail to notify the seller within the inspection period, the buyer's right to reject the modules shall be lapsed and the modules shall be deemed to have been accepted by the buyer.

13. Warranty

Inteltronic Inc. warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for one year from the date of purchase.

Inteltronic Inc. will be limited to replace or repair any of its module which is found and confirmed defective electrically or visually when inspected in accordance with Inteltronic Inc. general module inspection standard.

This warranty does not apply to any products which have been on customer's production line, repaired or altered by persons other than repair personnel authorized by Inteltronic Inc., or which have been subject to misuse, abuse, accident or improper installation. Inteltronic Inc. assumes no liability under the terms of this warranty as a consequence of such events.

If an Inteltronic Inc. product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. In returning the modules, they must be properly packaged with original package; there should be detailed description of the failures or defect.

14. RMA

Products purchased through Inteltronic Inc. and under warranty may be returned for replacement. Contact support@inteltronicinc.com for RMA number and procedures

Office Locations

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