2.8 inch TFT LCD
without Touch Panel
SPECIFICATION

MODEL NAME: LMTO2028BQN1

Date: 2014 / 03 / 20

Customer Signature		
Customer		
Approved Date	Approved By	Reviewed By

C O N T E N T S

1.RECORD OF REVISION

REV	DATE	PAGE	SUMMARY
0.1	2014.03.20	ALL	Preliminary specification was first issued.

2.MECHANICAL   SPECIFICATIONS

(1)	Number Of Dots (Dots)	240(R.G.B) X 320
(2)	Module Size(mm)	50(H) X 69.2(V) X 3(D) (**)
(3)	Active Area(mm)	43.2(H) X 57.6(V)
(4)	Pixel Pitch(mm)	0.180 (H) X 0.180(V)
(5)	LCD / Polarizer Model	TFT , Transmissive, Normally/White
(6)	Backlight Color	White, LED
(7)	Viewing Direction	6 O'clock Horizontal：Right side 45°(typ.), Left side 45°(typ.) Vertical：Up side 50°(typ.), Down side 20°(typ.)
(8)	Gray Scale Inversion Direction	12 O'clock
(9)	Electrical Interface	TTL Interface
(10)	Color Configuration	R.G.B Stripe
(11)	Module Weight(g)	TBD

(**)Module include FPC and component.

3. OUTLINE DIMENSIONS
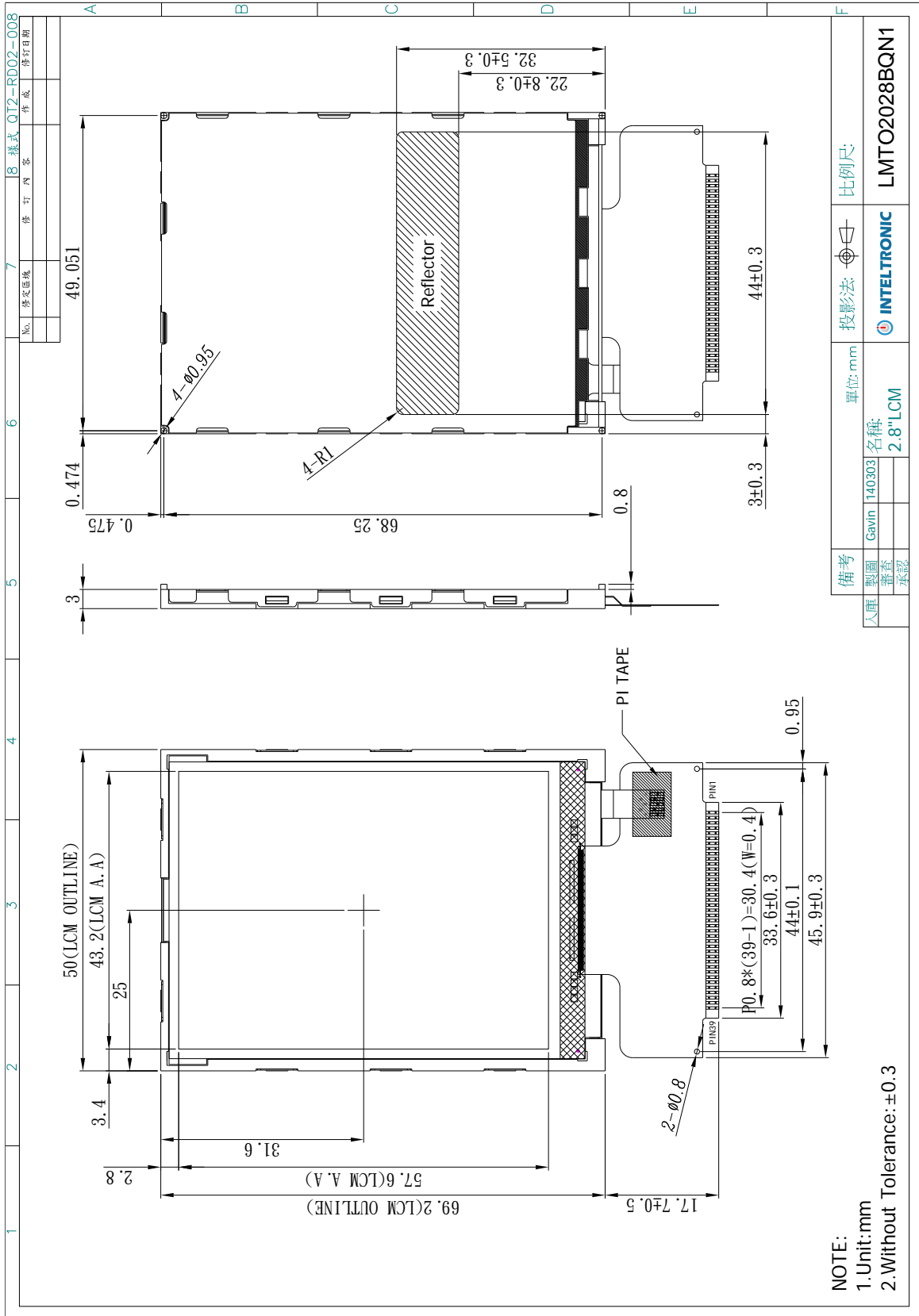
NOTE:
1.Unit:mm
2.Without Tolerance:±0.3

4. INTERFACE PIN CONNECTION

4.1 LCM PANEL DRIVING SECTION

FPC PITCH=0.8mm,47PIN

| PIN NO.	SIGNAL	FUNCTION	REMARK
1	LEDK	Backlight Unit(-)	
2	LEDA	Backlight Unit(+)	
3	GND	Ground	
4	VCC	Power Supply for analog circuit blocks (2.5-3.3V)	
5	GND	Ground	
6	CSX	Chip Select Signal	
7	WRX	Write execution control pin ; Serial Register select s Signal	
8	D/CX	Register select signal; Serial Interface Clock	
9	RD	Read Signal	
10	SDA	Serial Input Signal	
11	SDO	Serial Output Signal	
12	DB17	IC Data Bit17	
13	DB16	IC Data Bit16	
14	DB15	IC Data Bit15	
15	DB14	IC Data Bit14	
16	DB13	IC Data Bit13	
17	DB12	IC Data Bit12	
18	DB11	IC Data Bit11	
19	DB10	IC Data Bit10	
20	DB9	IC Data Bit9	
21	DB8	IC Data Bit8	
22	DB7	IC Data Bit7	
23	DB6	IC Data Bit6	
24	DB5	IC Data Bit5	
25	DB4	IC Data Bit4	
26	DB3	IC Data Bit3	
27	DB2	IC Data Bit2	
28	DB1	IC Data Bit1	
29	DB0	IC Data Bit0	
30	IM0	Select Interface Mode	
31	IM1		
32	IM2		
33	IM3		
34	ENABLE	Enable Clock Synchronization Signal Input For RGB Interface	
35	DCLK	Clock Input	

36	HSYNC	Line Synchronizing Signal For RGB Interface	
37	VSYNC	Frame Synchronizing Signal For RGB Interface	
38	RESET	Hardware Reset	
39	VDDI	Power Supply for interface logic circuits (1.65-3.3V)	

Note1:

IM3	IM2	IM1	IM0	MCU-INTERFACE MODE	Register/Content
0	0	0	0	8080 MCU 8-bit bus interface I	D[7:0]
0	0	0	1	8080 MCU 16-bit bus interface I	D[15:0]
0	0	1	0	8080 MCU 9-bit bus interface I	D[8:0]
0	0	1	1	8080 MCU 18-bit bus interface I	D[77:0]
0	1	0	1	3-wire 9-bit data serial interface I	SDA: in/out
0	1	1	0	4-wire 8-bit data serial interface I	SDA: in/out
1	0	0	0	8080 MCU 16-bit bus interface II	D[17:10],D[8:1]
1	0	0	1	8080 MCU 8-bit bus interface II	D[17:10]
1	0	1	0	8080 MCU 18-bit bus interface II	D[17:0]
1	0	1	1	8080 MCU 9-bit bus interface II	D[17:9]
1	1	0	1	3-wire 9-bit data serial interface II	SDA: in/ SDO: out
1	1	1	0	4-wire 8-bit data serial interface II	SDA: in/ SDO: out

5. BLOCK DIAGRAM
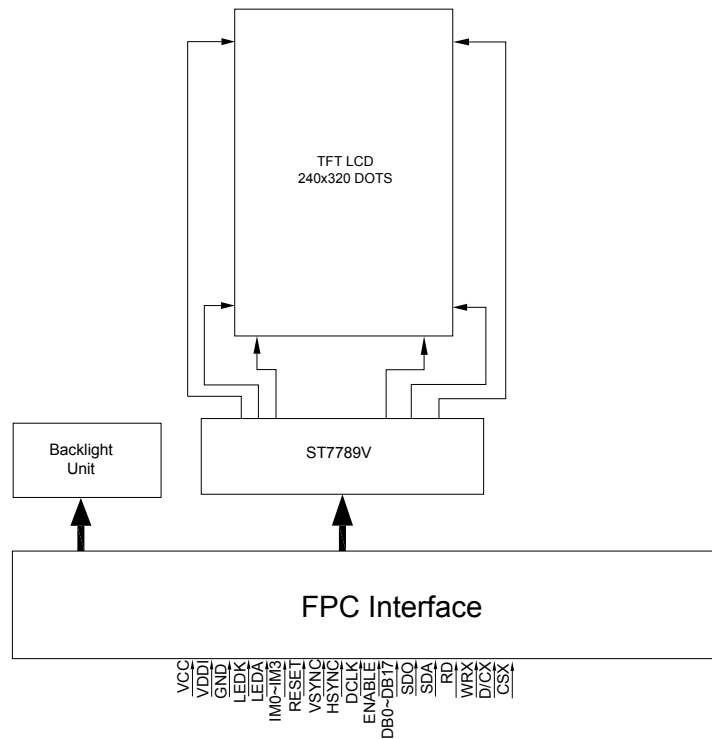
6. ABSOLUTE MAXIMUM RATINGS

6.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	REMARK
Supply Voltage	VDDI	-0.3	+4.6	V	
	VCC	-0.3	+4.6	V	
	VLED	-	3.7	V	

6.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	OPERATING		STORAGE		REMARK
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature(℃)	-20	70	-30	80	Note 1,2
Humidity(% RH)	Note 4		Note 4		Without condensation

Note 1 : The response time will become lower when operated at low temperature.
Note 2 : Background color changes slightly depending on ambient temperature.
Note 3 : Storage Ta=60℃ & RH=90%≦240Hrs.

7. ELECTRICAL CHARACTERISTICS

7.1 ELECTRICAL CHARACTERISTICS OF LCD

Ta=25℃

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Power Voltage For LCD	VCC	2.4	2.75	3.3	V	
	VDDI	1.65	1.8	3.3	V	
	ICC	-	TBD	TBD	mA	Note 1
High Level Input Voltage	VIH	0.7VDDI	-	VDDI	V	
Low Level Input Voltage	VIL	GND	-	0.3VDDI	V	

Note 1：Test condition：VCI =2.75V；Test Pattern：Black.

7.2 BACKLIGHT UNITS

Ta=25℃

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
LED Driving Voltage	VLED	-	3.25	3.7	V	
	ILED	-	80	-	mA	VLED=3.25V

A ○   ○ K
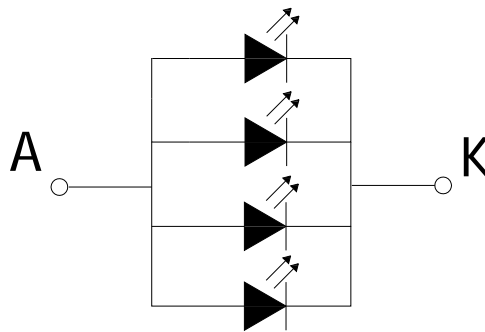
8. OPTICAL CHARACTERISTICS

Ta=25℃

ITEM		SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	REMARK
Contrast Ratio		CR		(400)	(500)	-	-	Note 1
Response Time		TR		-	4	8	ms	Note 2
		TF		-	12	24	ms	
Chromaticity	White	Wx	Viewing Normal Angle Θx=Θy=0°	TBD	TBD	TBD	-	Note 4
		Wy		TBD	TBD	TBD	-	
	Red	Rx		TBD	TBD	TBD	-	
		Ry		TBD	TBD	TBD	-	
	Green	Gx		TBD	TBD	TBD	-	
		Gy		TBD	TBD	TBD	-	
	Blue	Bx		TBD	TBD	TBD	-	
		By		TBD	TBD	TBD	-	
Viewing Angle	Hor.	θx+	Viewing Angle Θx=Θy=0° CR≧10	35	45	-	Deg.	Note 3
		θx -		35	45	-		
	Ver.	θy+		40	50	-		
		θy -		10	20	-		
Luminance		L	ILED=80mA	(250)	(300)	-	cd/m2	
Luminance Uniformity		YU		70	-	-	%	Note 5

Note 1：Definition of Contrast Ratio (CR)：
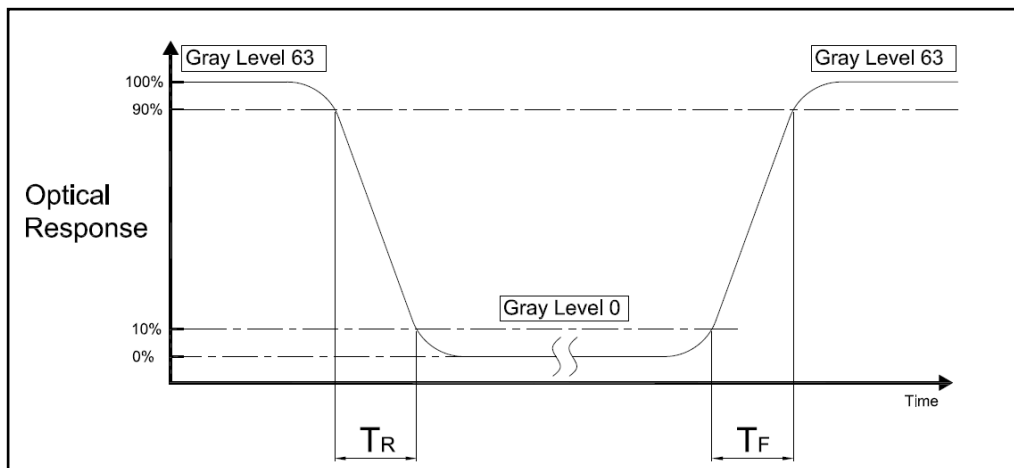The contrast ratio can be calculated by the following expression.
Contrast Ratio (CR) = L63/L0
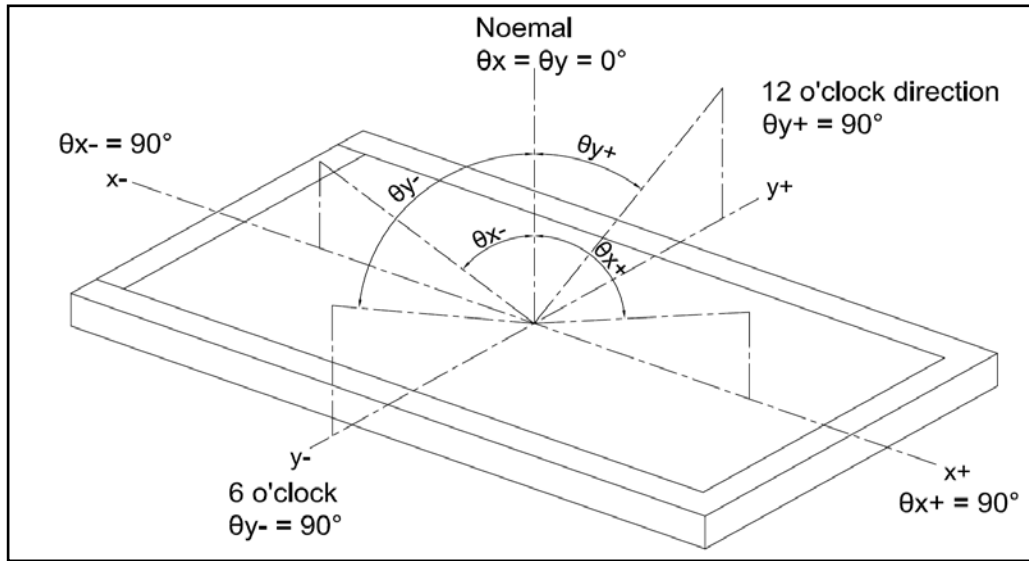L63：Luminance of gray level 63
L0：Luminance of gray level 0
CR = CR(5)
CR(X) is corresponding to the Contrast Ratio of the point X at Figure in Note 5

Note 2：Definition of Response Time (TR.TF)
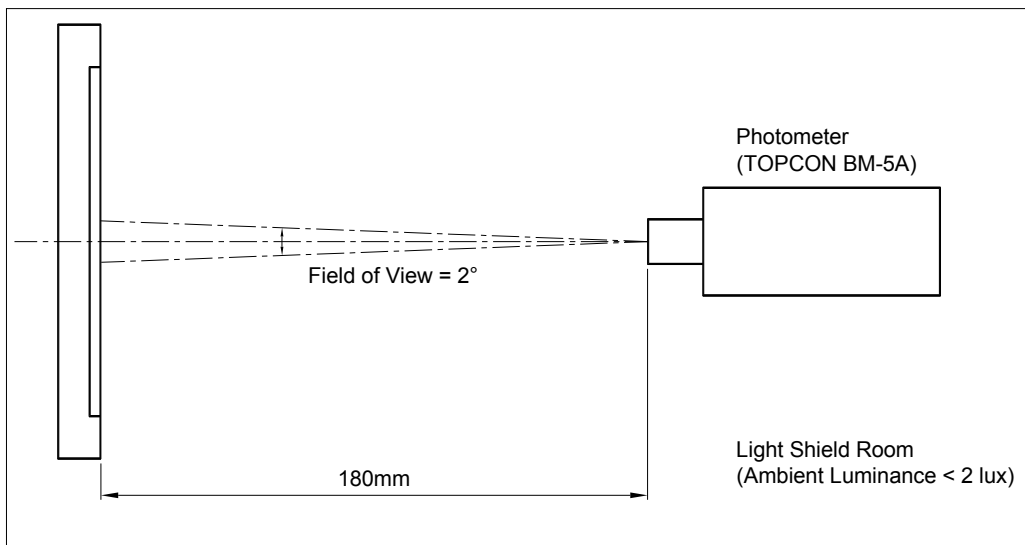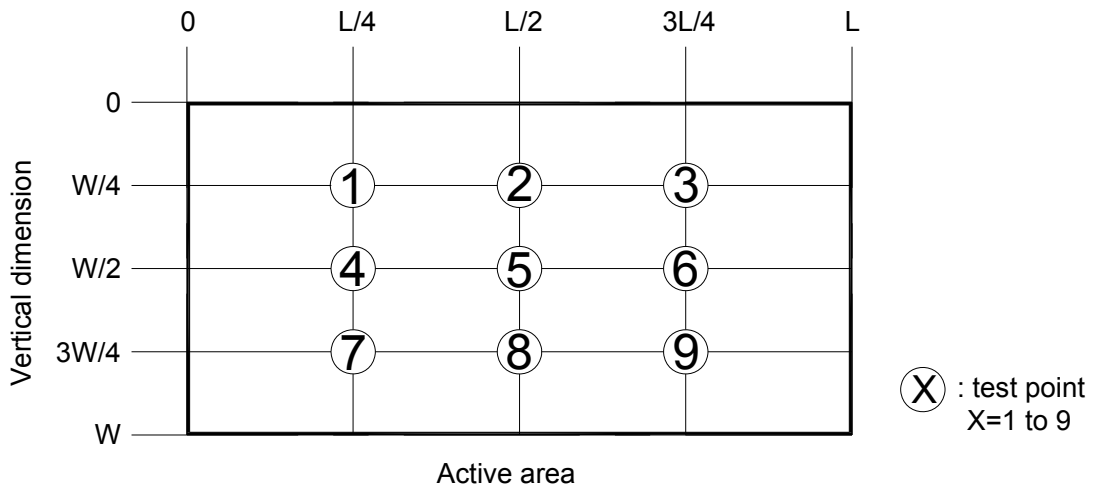
Note 3：Definition of Viewing Angle

Note 4：Measurement Set-Up:
The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

Note 5：

Vertical dimension

| | 0 | L/4 | L/2 | 3L/4 | L |

0

W/4 — ① ② ③

W/2 — ④ ⑤ ⑥

3W/4 — ⑦ ⑧ ⑨

W

Active area

Ⓧ : test point
X=1 to 9

$$\left[1 - \frac{\text{MAX Luminance - Average Luminance}}{\text{Average Luminance}} \right] \times 100\% \geqq 70\%$$

9. TIMING SPECIFICATIONS

9.1 POWER SUPPLY VOLTAGE SEQUENCE

9.1.1 AC TIMING DIAGRAMS

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Address setup time	tast	0	-	-	ns	
Address hold time (Write/Read)	taht	10	-	-	ns	
CSX "H" pulse width	tchw	0	-	-	ns	
Chip select setup time (Write)	tcs	15	-	-	ns	
Chip select setup time (Read ID)	trcs	45	-	-	ns	
Chip select setup time (Read FM)	trcsfm	355	-	-	ns	
Chip select wait time (Write/Read)	tcsf	10	-	-	ns	
Chip select hold time	tcsh	10			ns	
Write cycle	Twc	66	-	-	ns	
Write Control pulse "H" duration	twrh	15	-	-	ns	
Write Control pulse "L" duration	twrl	15	-	-	ns	
Read cycle(FM)	trcfm	450	-	-	ns	
Read Control "H" duration(FM)	trdhfm	90	-	-	ns	
Read Control "L" duration(FM)	trdlfm	355	-	-	ns	
Read cycle(ID)	trc	160	-	-	ns	
Read Control pulse "H" duration	trdh	90			ns	
Read Control pulse "L" duration	trdl	45			ns	
Write data setup time	tdst	10	-	-	ns	
Write data hold time	tdht	10	-	-	ns	
Read access time	trat	-	-	40	ns	
Read access time	tratfm	-	-	340	ns	
Read output disable time	trod	20	-	80	ns	
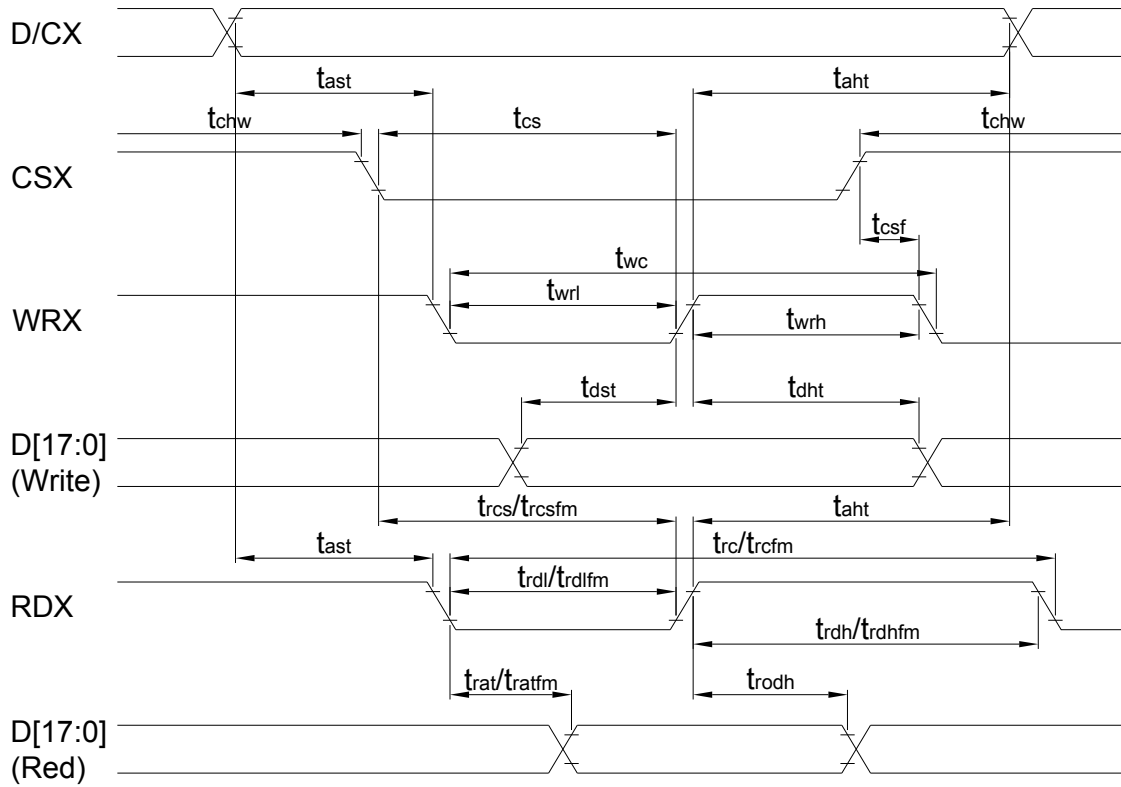
Note: Please refer to ST7789V data sheet for more details.

10. RELIABILITY TEST

ENVIRONMENTAL TEST				
NO.	ITEM	CONDITIONS	TIME PERIOD	REMARK
1	High Temperature Storage	(80℃)	240HRS	
2	Low Temperature Storage	(-30℃)	240HRS	
3	High Temperature Operation	(70℃)	240HRS	
4	Low Temperature Operation	(-20℃)	240HRS	
5	Temperature Cycle	(-30℃)◄►(80℃) (30min) (30min)	10CYCLE	
6	High Temperature Humidity Storage	(+60℃) (90%RH)	240HRS	

Note 1: a. The module should work properly.
      b. Before and after function test, The difference of consumptive current. Should be within 10%
Note 2: a. The module should work properly.
      b. The modlue won't be deformative, Color changeable or broken.
      c. The modules can't be apart.
Note 3: a. Before cosmetic and function test, The product must have enough recovery time, At least 2 hours at room temperature.

10.1 VIBRATION TEST：

10.1.1 STATE LABORATORY ENVIRONMENT：

Room temperature： 25±3℃
Relative humidity：55±20％RH

10.1.2 TEST METHOD / SPECIFICATION：

Sample Status： Non-packaged single state
Waveform： Sine
Frequency：10~55~10Hz
Full amplitude：1.5mm
Vibration direction：X,Y,Z Axis (3 Axial)
Test time： Each 2Hour / X,Y,Z Axis， Altogether 6 Hour

10.2 MECHANICAL SHOCK TEST：

10.2.1 STATE LABORATORY ENVIRONMENT：

Room temperature： 25±3℃
Relative humidity：55±20％RH

10.2.2 TEST METHOD / SPECIFICATION：

Sample Status： Non-packaged single state
Waveform： Half-sine
Acceleration：100G
Shock Time：6ms
Impact direction：6 Directions (±X, ±Y, ±Z axes)
Number of shocks： Each direction 3 Secondary， Altogether 18 Secondary

11.PRECAUTIONS FOR USE

11.1 SAFETY

(1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
(2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
(3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

11.2 STORAGE CONDITIONS

(1) Store the panel or module in a dark place where the temperature is 23±5°C and the humidity is below 50±20%RH.
(2) Store in anti-static electricity container.
(3) Store in clean environment, free from dust, active gas, and solvent.
(4) Do not place the module near organics solvents or corrosive gases.
(5) Do not crush, shake, or jolt the module.

11.3 HANDLING PRECAUTIONS

(1) Avoid static electricity which can damage the CMOS LSI.
(2) The polarizing plate of the display is very fragile. So, please handle it very carefully.
(3) Do not give external shock.
(4) Do not apply excessive force on the surface.
(5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the Surface of plate.
(6) Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
(7) Do not operate it above the absolute maximum rating.
(8) Do not remove the panel or frame from the module.
(9) When the module is assembled, it should be attached to the system firmly, Be careful not to twist and bend the module.
(10) Wipe off water droplets or oil immediately . If you leave the droplets for a long time, staining and discoloration may occur.
(11) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

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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