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LMT043DNFFWD

LCD Module User Manual

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Date:	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary	2012-04-18
0.2	Revise Timing Diagram	2012-10-10

Table of Content

1. General Specification	3
2. Block Diagram.....	3
3. Terminal Functions.....	4
3.1 Interface	4
4. Absolute Maximum Ratings	5
5. Electrical Characteristics	5
5.1 DC Characteristics (MCU terminal).....	5
5.2 LED Backlight Circuit Characteristics	5
5.3 AC Characteristics.....	6
5.3.1 AC Timing.....	6
5.3.2 Data Timing	7
6. Optical Characteristics	8
7. Function Specifications.....	10
7.1 Power On/Off Sequence.....	10
8. Precautions of using LCD Modules	11
9. Appendix A <Inspection items and criteria for appearance defect>	12

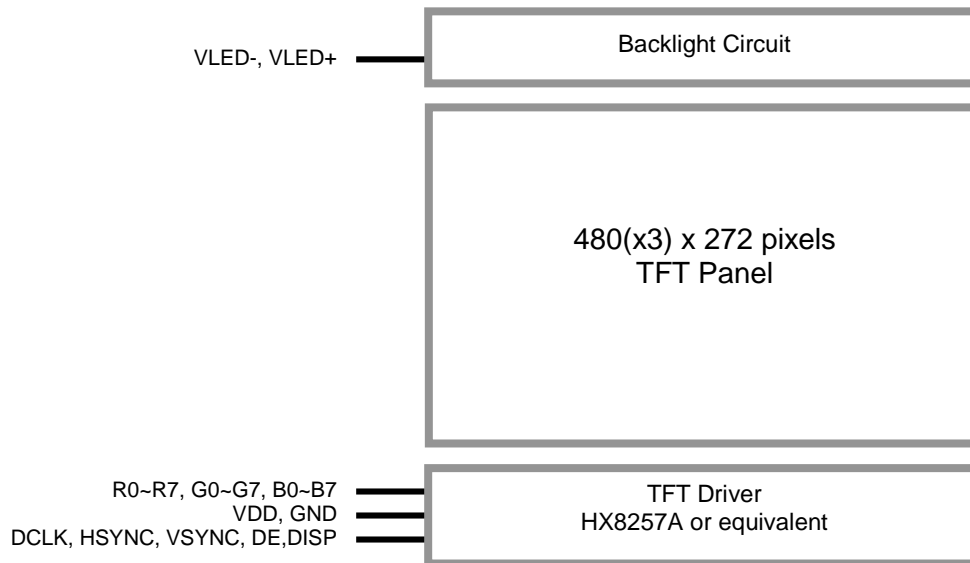
1. General Specification

Screen Size(Diagonal) :	4.3 inch
Resolution :	480(RGB) x 272
Signal Interface :	24bit parallel interface
Color Depth :	16.7M color (24bit) *1
Dot Pitch :	0.198 x 0.198 (mm)
Pixel Configuration :	RGB Stripe
Display Mode :	Transmissive / Positive (normal white)
Surface Treatment :	Anti-Glare Treatment
Viewing Direction :	12 o'clock (Gray Scale Inversion Direction)
Outline Dimension :	105.5 x 67.2 x 2.9 (mm)
	(exclude FPC, see attached drawing for details)
Active Area :	95.04 x 53.86 (mm)
Weight :	(44.1g)
Backlight :	2x5 LEDs
Driver IC	HX8257A
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

Note:

*1 Color tune may slightly changed by temperature and driving voltage.

2. Block Diagram



3. Terminal Functions

3.1 Interface

Pin No.	Pin Name	I/O	Descriptions
1	VLED-	P	Backlight LED Cathode supply
2	VLED+	P	Backlight LED Anode supply
3	GND	P	Power Ground (0V)
4	VDD	P	Positive Power Supply
5	R0	I	Red color data input
:	:		
12	R7		
13	G0	I	Green color data input
:	:		
20	G7		
21	B0	I	Blue color data input
:	:		
28	B7		
29	GND	P	Power Ground (0V)
30	DCLK	I	Data clock signal input, rising edge trigger
31	DISP	I	Display on/of control (internally pull high) DISP=1: normal operation DISP=0: standby mode
32	HSYNC	I	Horizontal Sync signal input (negative polarity, internally pull high) (If not using, pull high)
33	VSYNC	I	Vertical Sync Signal Input (negative polarity, internally pull high) (If not using, pull high)
34	DE	I	Data Enable Signal Input (internal pull low) (If not using, pull low)
35	NC	-	No connection, leave open
36	GND	P	Power Ground (0V)
37	NC	-	No connection, leave open
38	NC		
39	NC		
40	NC		

Note:

The LMT043DNFFWD both supports DE mode and Sync mode timing.
 SYNC mode, DE pull-lo, HSYNC and VSYNC for timing control
 DE mode, HSYNC and VSYNC pull-hi, DE for timing control

4. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V _{DD}	-0.3	+4.0	V	GND = 0V
Operating Temperature	T _{OP}	-20	+70	°C	No Condensation
Storage Temperature	T _{ST}	-30	+80	°C	No Condensation

Cautions:

Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

5. Electrical Characteristics

5.1 DC Characteristics (MCU terminal)

GND=0V, V_{DD} =3.3V, T_{OP} =25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	V _{DD}	3.0	3.3	3.6	V	VDD
Input High Voltage	V _{IH}	0.7VDD	-	VDD	V	Input pins
Input Low Voltage	V _{IL}	GND	-	0.3VDD	V	Input pins
Frame Freq	F _{FRAME}	-	60	-	Hz	
Dot Data Clock	f _{DOTCLK}	-	9.0	15	MHz	
Operating Current (*1)	I _{DD}	-	22.4	-	mA	VDD
Standby Current (*2)	I _{DD}	-	15.2	-	uA	VDD

Note.

*1. test image is Black Mode, Frame Freq=60Hz

*2. DISP=0

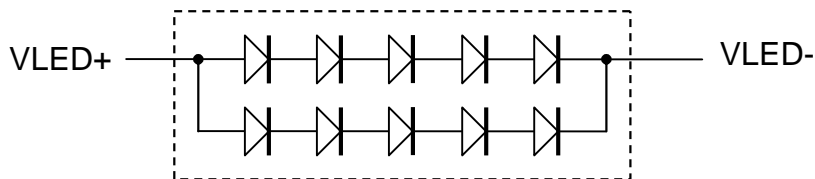
5.2 LED Backlight Circuit Characteristics

I_{fVLED+}=40mA, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Forward Voltage	V _f	-	16.0	-	V	
Forward Current	I _{fVLED+}	-	40	50	mA	
Life Time	-	10,000	(20,000)	-	hr	

Cautions:

Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



No. of LEDs = 2x5 pcs

5.3 AC Characteristics

5.3.1 AC Timing

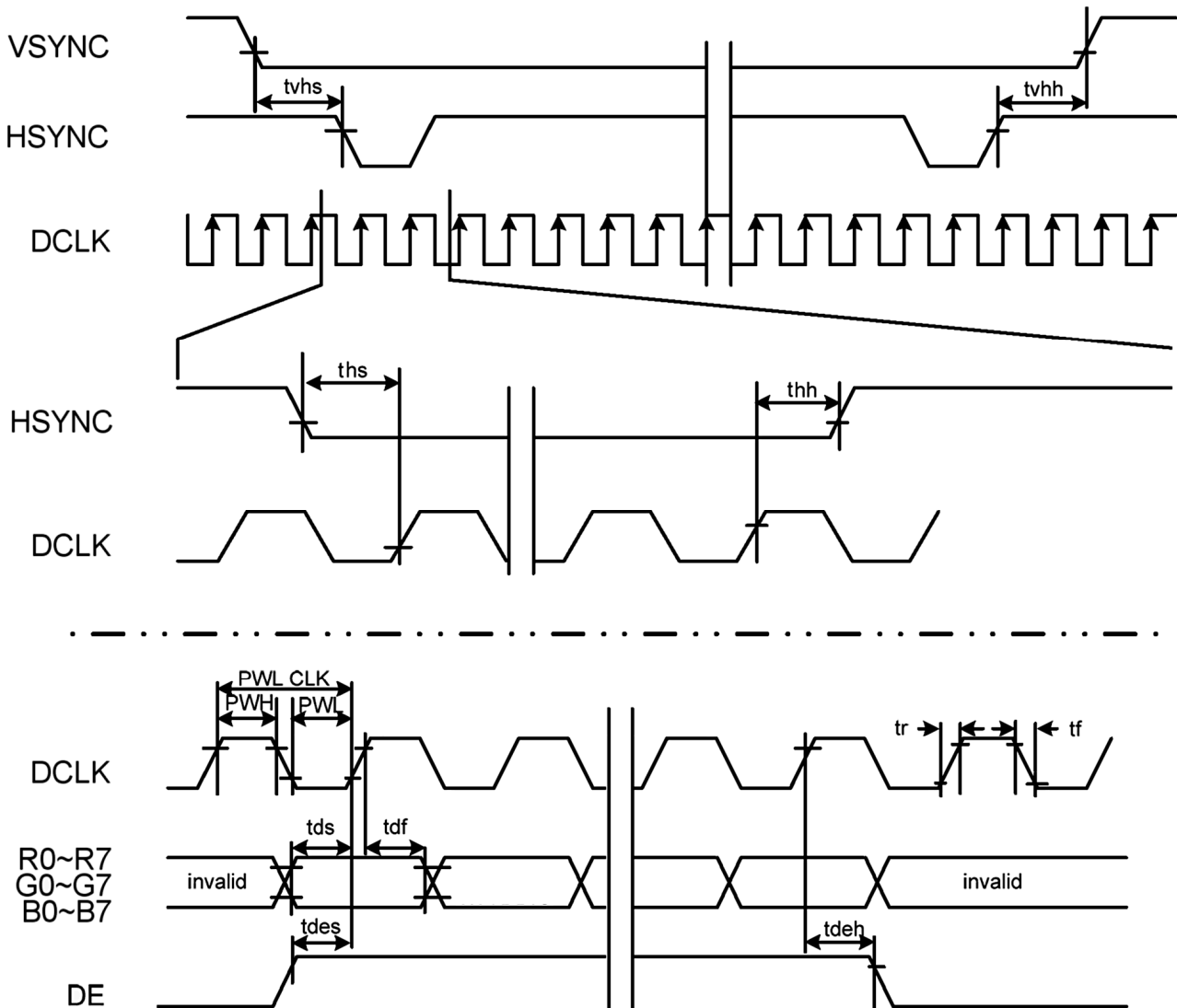
GND=0V, V_{DD} =3.3V, T_{OP} =25°C

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock period	PW _{CLK} ⁽²⁾	66.7	-	-	ns
Clock pulse high period	PWH ⁽²⁾	26.7	-	-	ns
Clock pulse low period	PWL ⁽²⁾	26.7	-	-	ns
Hsync setup time	t _{hs}	10	-	-	ns
Hsync hold time	t _{hh}	10	-	-	ns
Data setup time	t _{ds}	10	-	-	ns
Data hold time	t _{dh}	10	-	-	ns
DE setup time	t _{des}	10	-	-	ns
DE hold time	t _{deh}	10	-	-	ns
Vsync setup time	t _{vhs}	10	-	-	ns
Vsync hold time	t _{vhh}	10	-	-	ns

Note:

*1. tr, tf ≤ 2ns, which defined 10% ~90% fo signal amplitude

*2. DCLK ≤ 15MHz



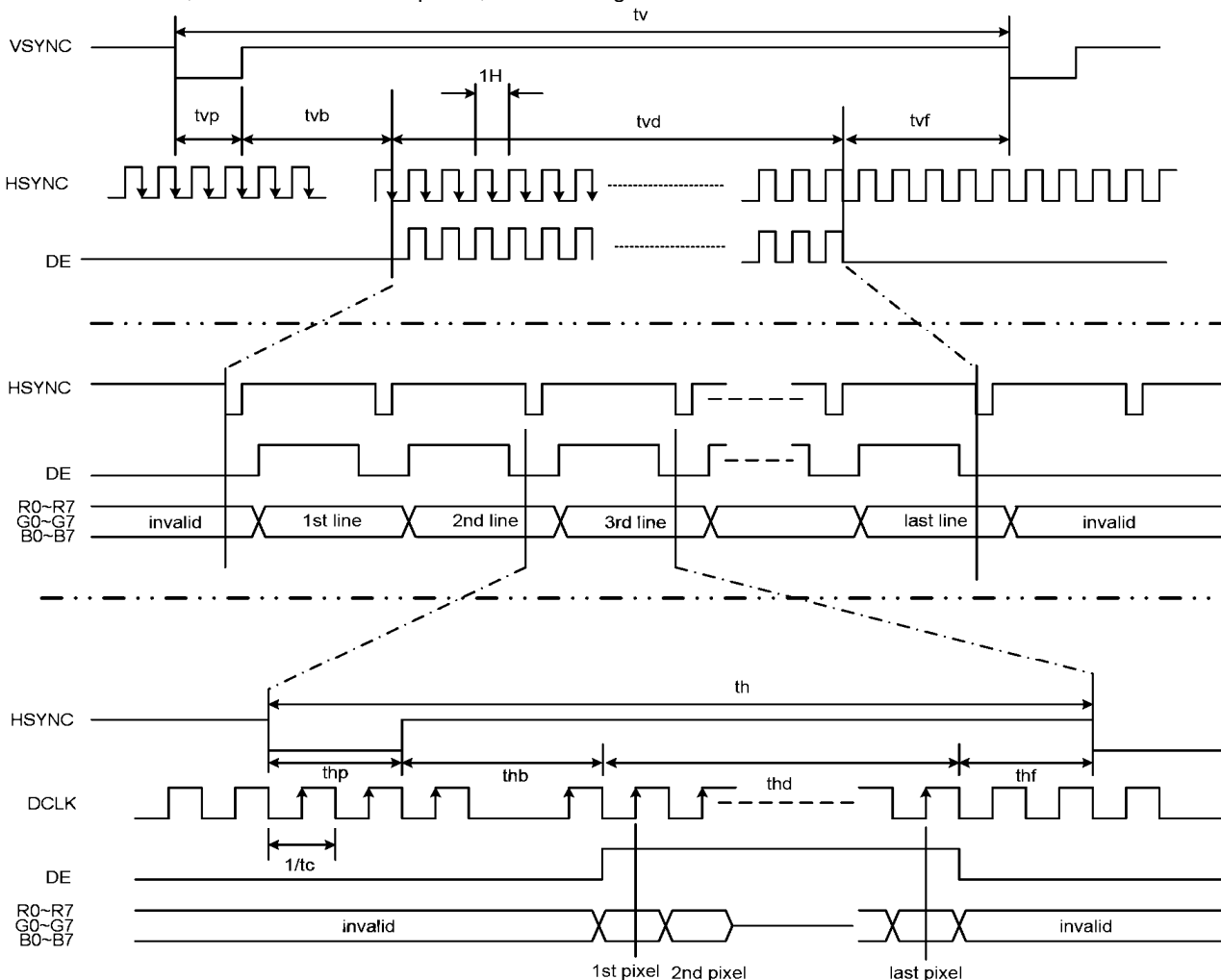
Timing Diagram

5.3.2 Data Timing

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	$f_{CLK}^{(1)}$	-	9	15	MHz
Hsync cycle	$1/th$	-	17.14	-	KHz
Vsync cycle	$1/tv$	-	59.94	-	Hz
Horizontal Signal					
Horizontal cycle	th	525	525	605	CLK
Horizontal display period	thd	480	480	480	CLK
Horizontal front porch	thf	2	2	82	CLK
Horizontal pulse width	thp ⁽²⁾	2	41	41	CLK
Horizontal back porch	thb ⁽²⁾	2	2	41	CLK
Vertical Signal					
Vertical cycle	tv	285	286	399	H ⁽¹⁾
Vertical display period	tvd	272	272	272	H ⁽¹⁾
Vertical front porch	tvf	1	2	227	H ⁽¹⁾
Vertical pulse width	tvp ⁽²⁾	1	10	11	H ⁽¹⁾
Vertical back porch	tvb ⁽²⁾	1	2	11	H ⁽¹⁾

Note:

- *1 Unit: C:L=1/f_{CLK}, H=th
- *2. It is necessary to keep tvp+tvb=12 and thp+thb=43 in SYNC mode.
But not necessary for DE mode.
- *3. The LMT043DNFFWD both supports DE mode and Sync mode timing.
SYNC mode, DE pull-lo, HSYNC and VSYNC for timing control
DE mode, HSYNC and VSYNC pull-hi, DE for timing control



Input Data Timing Diagram

6. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles	θT	$CR \geq 10$	60	70	--	Degree	Note 2
	θB		40	50	--		
	θL		60	70	--		
	θR		60	70	--		
Contrast Ratio	CR	$\theta=0^\circ$	400	500	--		Note1、Note3
Response Time	T_{ON}	25°C	--	20	30	ms	Note1 Note4
	T_{OFF}						
Chromaticity	White	Backlight is on	x	0.265	0.315	0.365	Note5 Note1
			y	0.285	0.335	0.385	
	Red		x	0.531	0.581	0.631	
			y	0.295	0.345	0.395	
	Green		x	0.298	0.348	0.395	
			y	0.531	0.581	0.631	
	Blue		x	0.103	0.153	0.203	
			y	0.045	0.095	0.145	
Uniformity	U		75	80	--	%	Note1、Note6
NTSC			--	50	--	%	Note 5
Luminance	L		250	300	--	cd/m ²	Note1、Note7

Note:

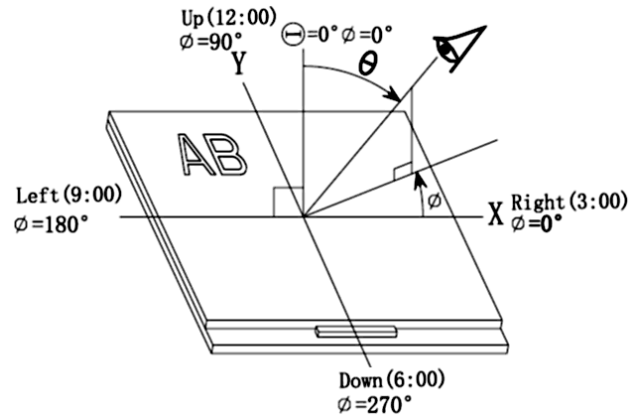
The parameter is slightly changed by temperature, driving voltage and material
Please see the Notes for testing conditions

Note 1:

The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment SR-3A (1°)
 Measuring condition:
 - Measuring surroundings: Dark room
 - Measuring temperature: Ta=25°C.
 - Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:

The definition of viewing angle:
 Refer to the graph below marked by θ and ϕ



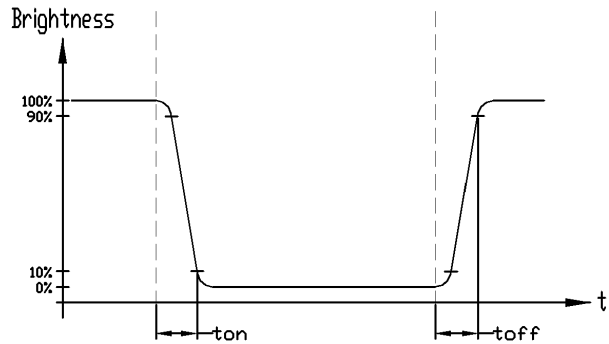
Note 3:

The definition of contrast ratio (Test LCM using SR-3A (1°):

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$
 (Contrast Ratio is measured in optimum common electrode voltage)

Note 4:

Definition of Response time. (Test LCD using BM-7A(2°)):
 The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.

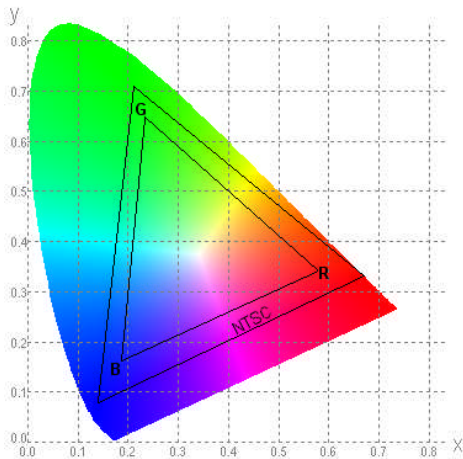


Note 5:

Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



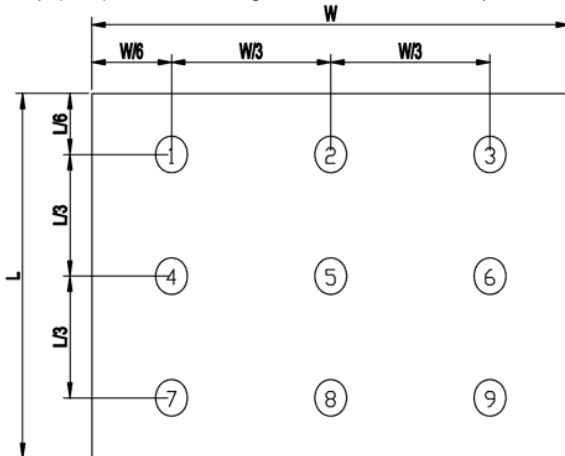
Note 6:

The luminance uniformity is calculated by using following formula.

$$\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$$

$$Bp (\text{Max.}) = \text{Maximum brightness in 9 measured spots}$$

$$Bp (\text{Min.}) = \text{Minimum brightness in 9 measured spots.}$$



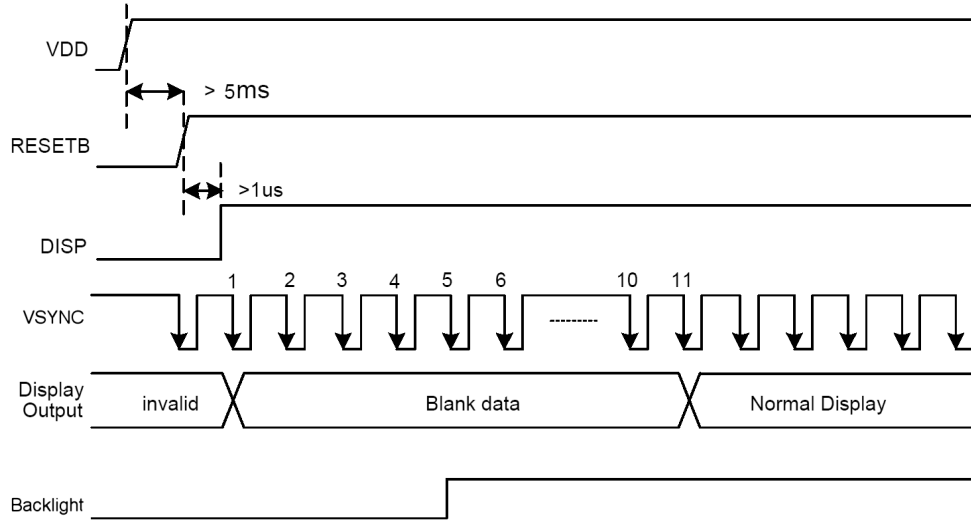
Note 7:

Measured the luminance of white state at center point

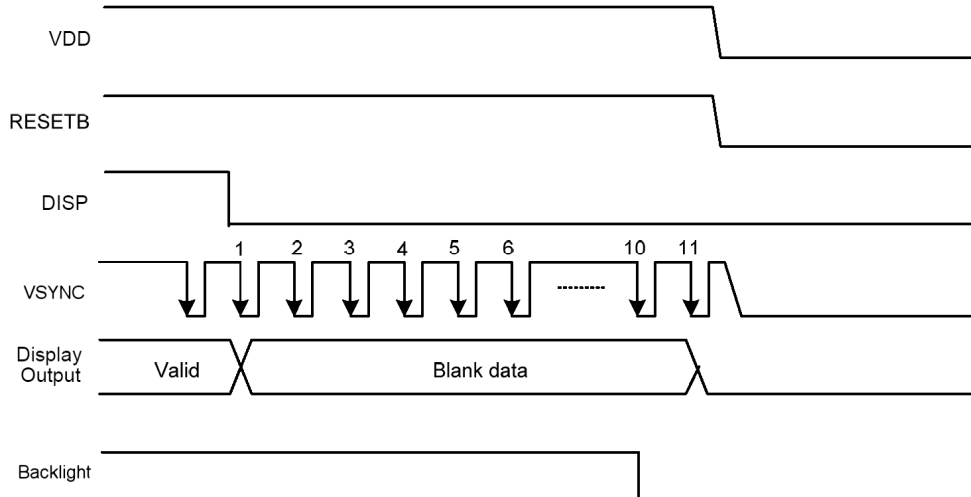
7. Function Specifications

7.1 Power On/Off Sequence

Power On Timing Sequence



Power Off Timing Sequence



To prevent abnormal display that might show on screen, it is suggest to use to following standby sequence.

Power on, turn on the backlight AFTER power supply stable and display ready.

Power off, turn off the backlight BEFORE power down.

8. Precautions of using LCD Modules

Mounting

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating

- The spike noise causes the mis-operation of circuits. It should be within the $\pm 200\text{mV}$ level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

Storage

When storing modules as spares for a long time, the following precautions are necessary.

- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

Protection Film

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Transportation

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

9. Appendix A <Inspection items and criteria for appearance defect>

Items	Criteria			
Open Segment or Common	Not permitted			
Short	Not permitted			
Wrong Viewing Angle	Not permitted			
Decliners	Not permitted			
Contrast Ration Uneven	According to the limit specimen			
Crosstalk	According to the limit specimen			
White spots	X>1 pixel	A-area	Not permitted	Max 6 spots allowed
		B-area	Max. 1 allowed	
	1/2 pixel<X≤1 pixel	A-area	Not permitted	
		B-area	Max. 2 allowed	
	X≤1/2 pixel	A-area	Max. 1 allowed	
		B-area	Max. 4 allowed	
Black Sport	X>1 pixel	A-area	Not permitted	
		B-area	Max. 2 allowed	
	X≤1/2 pixel	A-area	Max. 1 allowed	
		B-area	Max. 4 allowed	
Line Defect	Apparent vertical horizontal line defects are not permitted			

Note:

1. On Pixel include 3 dots (RedDot + GreenDot + BlueDot)
2. Definition of Panel "A-area" and "B-area"

