深圳市拓普微科技开发有限公司
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LMT035KDH03-2

LCD Module User Manual

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Date: 2018-10-18	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary	2013-09-04
0.2	Update section 3	2018-10-18

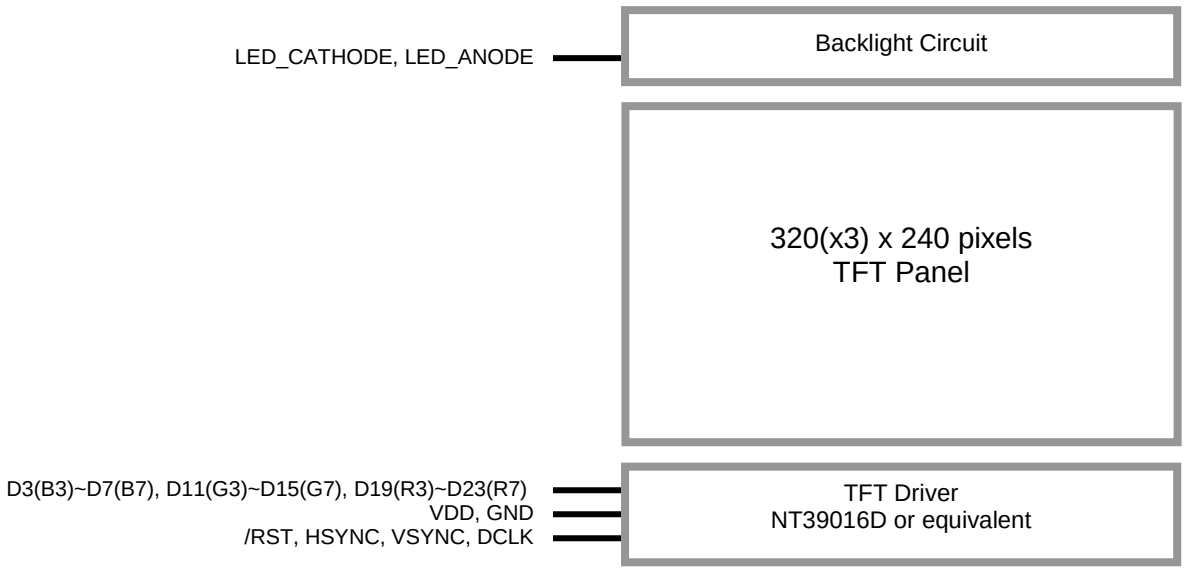
Table of Content

1. General Specification

Screen Size(Diagonal) :	3.5 inch
Resolution :	320(RGB) x 240
Signal Interface :	15bit parallel bus
Color Depth :	32k color (15bit) *1
Dot Pitch :	0.219 x 0.219 (mm)
Pixel Configuration :	RGB Stripe
Display Mode :	Transmissive / Positive
Surface Treatment :	Anti-Glare Treatment
Viewing Direction :	6H (*2) (gray scale inverse) 12H (*3)
Outline Dimension :	76.9 x 63.9 x 8.05 (mm) (exclude FPC, see attached drawing for details)
Active Area :	70.08 x 52.56 (mm)
Weight :	(29.3g)
Backlight :	6 LEDs (in series)
Driver IC	NT39016D
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

Note:
*1. Color tune may slightly changed by temperature and driving voltage.
*2. For saturated color display content (eg. pure-red, pure-green, pure-blue, or pure-colors-combinations)
*3. For "color scales" display content

2. Block Diagram



3. Terminal Functions

3.1 Interface

Pin No.	Pin Name	I/O	Descriptions
1	LED_CATHODE	P	Backlight LED Cathode supply
2	LED_ANODE	P	Backlight LED Anode supply
3	/RST	I	Reset signal active LOW
4	D3(B3)	I	B3~B7 Blue data input(*2)
:	:		
8	D7(B7)		
9	D11(G3)	I	G3~G7 Green data input (*2)
:	:		
13	D15(G7)		
14	D19(R3)	I	R3~R7 Read data input (*2)
:	:		
18	D23(R7)		
19	HSYNC	I	Horizontal Sync Signal
20	VSYNC	I	Vertical Sync Signal
21	GND	P	Power Ground Supply
22	DCLK	I	Data Clock Input
23	GND	P	Power Ground Supply
24	VDD	P	Positive Power Supply

4. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+4.0	V	GND = 0V
Input Voltage	V_{IN}	-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

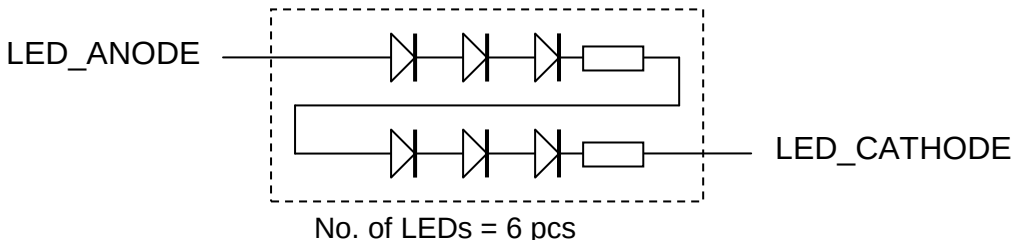
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	V_{DD}	3.0	3.3	3.6	V	VDD
Input High Voltage	V_{IH}	0.8VDD	-	VDD	V	Input pins
Input Low Voltage	V_{IL}	GND	-	0.2VDD	V	Input pins
Operating Current	I_{DD}	-	8.7	27	mA	VDD

5.2 LED Backlight Circuit Characteristics

$If_{LED\ ANODE}$=20mA, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Forward Voltage	$Vf_{LED\ ANODE}$	-	19.2	-	V	
Forward Current	$If_{LED\ ANODE}$	-	20	25	mA	
Life Time	-	-	(50000)	-	hr	

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



No. of LEDs = 6 pcs

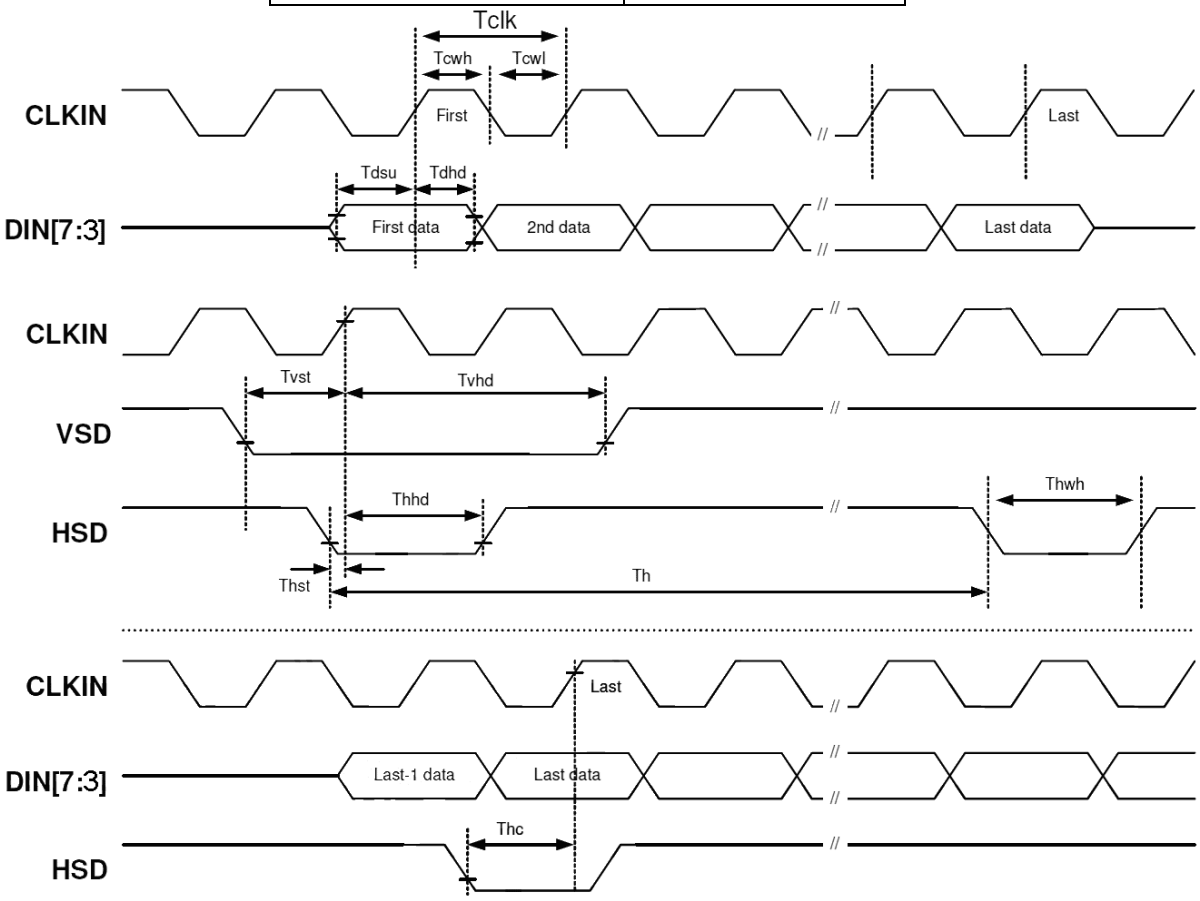
5.3 AC Characteristics

5.3.1 Display Data Input Timing

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
VDD power source slew time	T_{POR}			1000	us	From 0V to 90% VDD
RSTB active pulse width	T_{RSTB}	40			us	VDD = 3.3V
CLKIN clock time	Tclk	33.3/125	-	-	ns	Please refer to timing table
HSD to CLKIN	Thc	-	-	1	CLKIN	
HSD width	Thwh	1	-	-	CLKIN	
VSD width	Tvwh	1	-	-	Th	
HSD period time	Th	60	63.56	67	us	
VSD setup time	Tvst	8	-	-	ns	
VSD hold time	Tvhd	10	-	-	ns	
HSD setup time	Thst	8	-	-	ns	
HSD hold time	Thhd	10	-	-	ns	
Data set-up time	Tdsu	8	-	-	ns	DIN[23:3] to CLKIN
Data hold time	Tdhd	10	-	-	ns	DIN[23:3] to CLKIN

Signal naming references:

Terminal Name	Signal Name
D23~D19 & D15~D11 & D7~D3	DIN[23~19, 15~11, 7~3]
DCLK	CLKIN
HSYNC	HSD
VSYNC	VSD



Timing Diagram

5.4 Reset Function

To prevent from abnormal reset condition, a glitch filter for RSTB is embedded in this chip. The external reset signal should keep active for large then reset time (T_{RSTB}). Refer to the AC/DC Specification for the requirement.

6. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		θ=0° Φ=0°	-	250	-	Cd/m^2	1
Uniformity	△Bp			80%	-	-		1,2
Viewing Angle	θ1 (Φ=90° or270°)		Cr≥10	-25～+60			Deg	3
	θ2 (Φ=0° or 180°)			-45～+45				
Contrast Ratio	Cr		θ=0° Φ=0°	-	300	-	-	4
Response Time	T_r			-	25	40	ms	5
	T_f			-	25	40	ms	
Color of CIE Coordinate	W	x	θ=0° Φ=0°	-	0.29	-	-	1,6
		y		-	0.31	-	-	
	R	x		-	0.60	-	-	
		y		-	0.37	-	-	
	G	x		-	0.34	-	-	
		y		-	0.57	-	-	
	B	x		-	0.15	-	-	
		y		-	0.09	-	-	
NTSC Ratio	S			50	-		%	

Note：The parameter is slightly changed by temperature, driving voltage and materiel.

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 PR-705 (Φ8mm)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

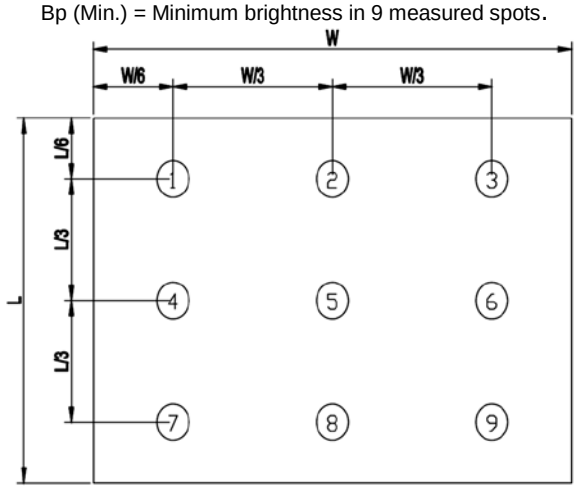
Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

Note 2:
The luminance uniformity is calculated by using following formula.

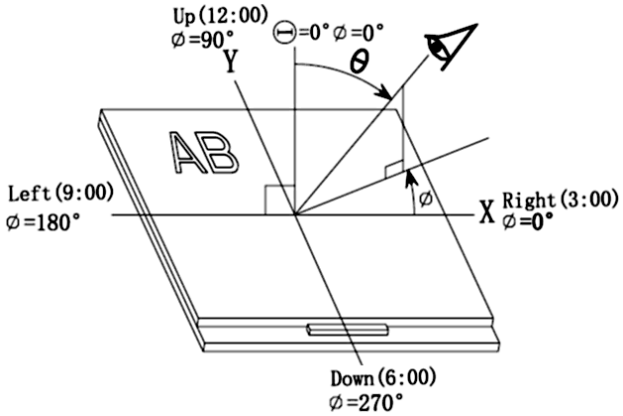
△Bp = Bp (Min.) / Bp (Max.)×100 (%)

Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.



Note 3:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ

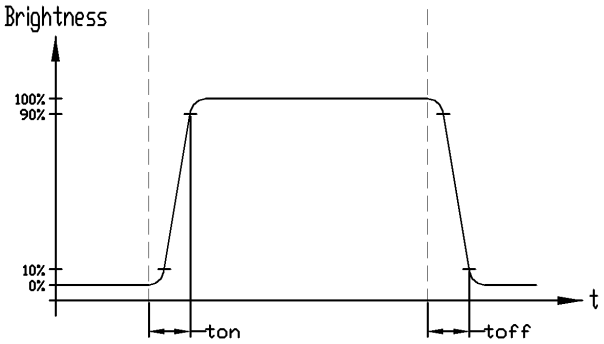


Note 4:
The definition of contrast ratio (Test LCM using PR-705):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

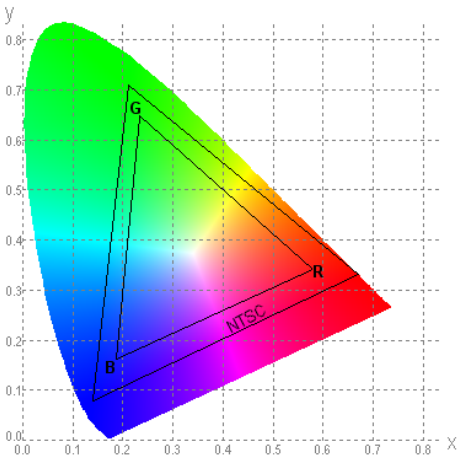
Note 5:
Definition of Response time. (Test LCD using DMS501):
The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



Note 6:
Definition of Color of CIE Coordinate and NTSC Ratio.

Color gamut:

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



7. 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 ±200mV 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.

8. 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”