



深圳市拓普微科技开发有限公司

SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LMT035KDH03-NJN

LCD Module User Manual

Prepared by: Caiwei Date: 2022-06-08	Checked by: Date:	Approved by: Date:
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Rev.	Descriptions	Release Date
0.1	New release	2021-10-09
0.2	Add LCD Module design picture	2021-01-04
0.3	Updata Outline Dwg	2022-06-08

Table of Content

1. General Specification	3
2. Block Diagram.....	3
2.1 Terminal Functions	4
3. Absolute Maximum Ratings	4
4. Electrical Characteristics	4
4.1 DC Characteristics	4
4.2 AC Characteristics.....	5
4.2.1 8080 Mode Timing	5
4.2.2 Reset Timing	6
5. Optical Characteristics	7
6. Function Specifications.....	9
6.1 Command Summary	9
7. LCD Module Design and Handling Precautions.....	10

1. General Specification

Screen Size(Diagonal) :	3.5 inch
Active Area :	70.08 x 52.56 (mm)
Number of dots :	320(RGB) x 240
Pixel Pitch:	0.219 x 0.219 (mm)
Color Depth:	2bpp
Display Technology :	a-Si TFT active matrix
Display Mode :	Normal White, Transmissive
Display Interface :	MCU Interface
Viewing Direction :	6 o'clock(Gray scale Inversion) (*1) 12 o'clock (*2)
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

Note:

*1. For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors-combinations).

*2. For "color scales" display content.

2. Block Diagram

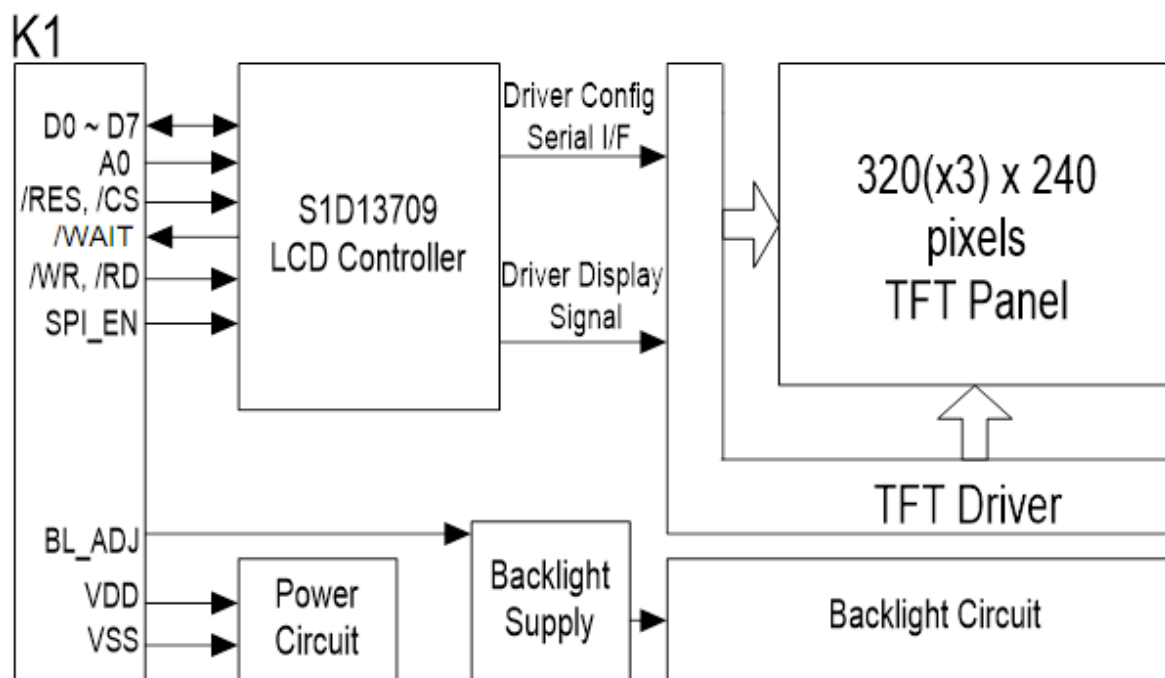


Figure 1

2.1 Terminal Functions

Terminal (K1/K2)

Pin No.(K1)	Pin No.(K2)	Pin Name	I/O	8bit MCU Mode (Default) Description
1	1,2	VSS	Power Input	Power Supply GND (0V)
2	3,4	VDD	Power Input	Positive Power Supply
3		NC	-	No Connect
4	18	/WR	Input	Write Enable, active Low
5	17	/RD	Input	Read Enable, active Low
6	6	/CS	Input	Chip Select /CS=Low: Data IO is enabled
7	5	A0	Input	Access Mode A0=High: Accessing Data A0=Low: Accessing Address
8	7	/RES	Input	Reset /RES=Low: Reset /RES=High: Normal operation
9	8	DB0	Bi-directional I/O	8-bit Bi-directional data bus
:	:	DB1		
14	13	:		
15	14	DB6		
16	15	DB7		
17	16	/WAIT	Output	WAIT Signal
18		NC	-	No Connect
19	19	BL_ADJ	Input	Backlight Driver enable signal, active High, PWM(*1) can be possible
20	20-24	NC	-	No Connect

Note:

*1. The PWM frequency is between 200Hz and 500Hz

3. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.2	3.6	V	$V_{SS} = 0V$
Input Voltage	V_{IN}	-0.2	VDD	V	$V_{SS} = 0V$
Operating Temperature	T_{OP}	-20	+70	°C	No Condensation
Storage Temperature	T_{ST}	-30	+80	°C	No Condensation

Caution:

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.

4. Electrical Characteristics

4.1 DC Characteristics

$V_{SS}=0V$, $V_{DD}=3.3V$, $T_{OP}=25^{\circ}C$

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}	0.8V _{DD}	-	VDD	V	Input pins, Bi-direction pins
Input Low Voltage	V_{IL}	VSS	-	0.2VDD	V	Input pins, Bi-direction pins
Operating Current	I_{DD}	-	155	200	mA	On Backlight Power on status

4.2 AC Characteristics

4.2.1 8080 Mode Timing

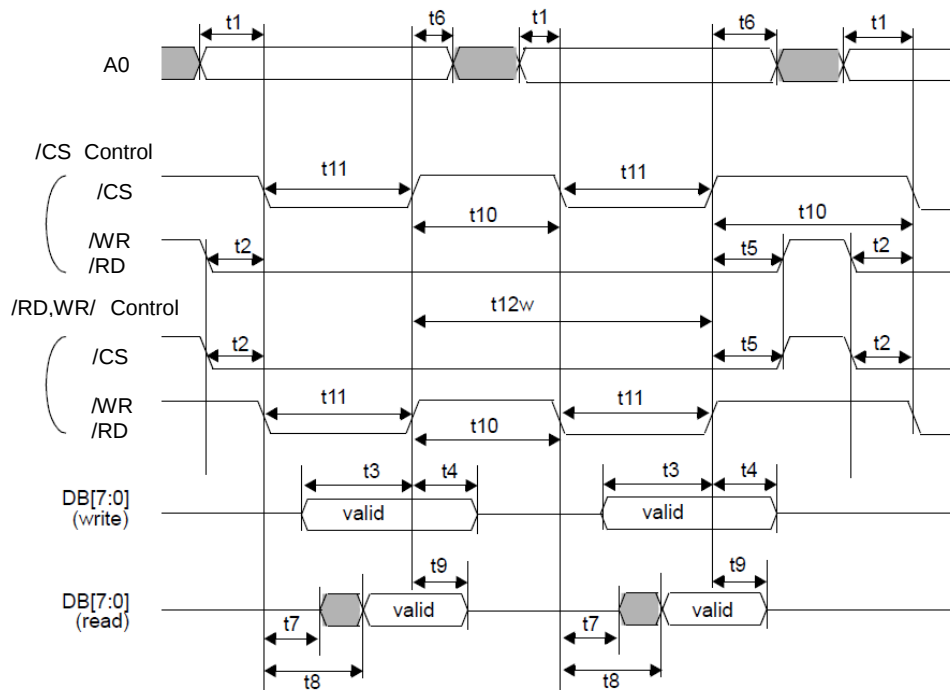


Figure 2

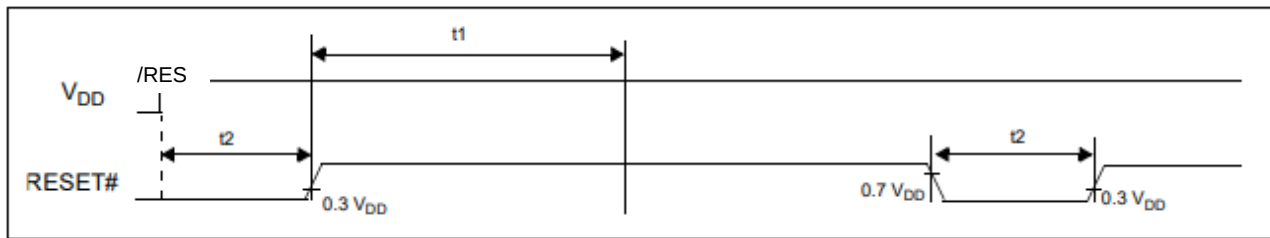
Symbol	Parameter	3.3 Volt		Units
		Min	Max	
t1	A0 setup time to /CS (/WR, /RD)	1	-	ns
t2	/WR, /RD (/CS) setup time to /CS (/WR, /RD)	1	-	ns
t3	DB[7:0] setup time to /CS (/WR) rising edge: write cycle	1	-	ns
t4	DB[7:0] hold time from /CS (/WR) rising edge: write cycle	7	-	ns
t5w	/WR (/CS) hold time from /CS (/WR) rising edge: write cycle	3	-	ns
t5r	/RD (/CS) hold time from /CS (/RD) rising edge: read cycle	0	-	ns
t6	A0 hold time from /CS (/WR, /RD) rising edge	4	-	ns
t7	/CS (/RD) falling edge to DB[7:0] driven: read cycle	-	15	ns
t8	/CS (/RD) falling edge to valid Data: read cycle	-	$4 \times T_{mclk} + 17$	ns
t9	DB[7:0] hold time from /CS (/RD) rising edge: read cycle	2	12	ns
t10w	End of write to next read/write	5	-	ns
t10r	End of read to next read/write	$T_{mclk} + 9$	-	ns
t11w	/CS (/WR) pulse width for write cycle	3	-	ns
t12w	/CS (/WR) rise to next /CS (/WR) rise: write cycle	$3 \times T_{mclk} + 6$	-	ns

Note: T_{mclk} = period of internal MCLK clock signal.

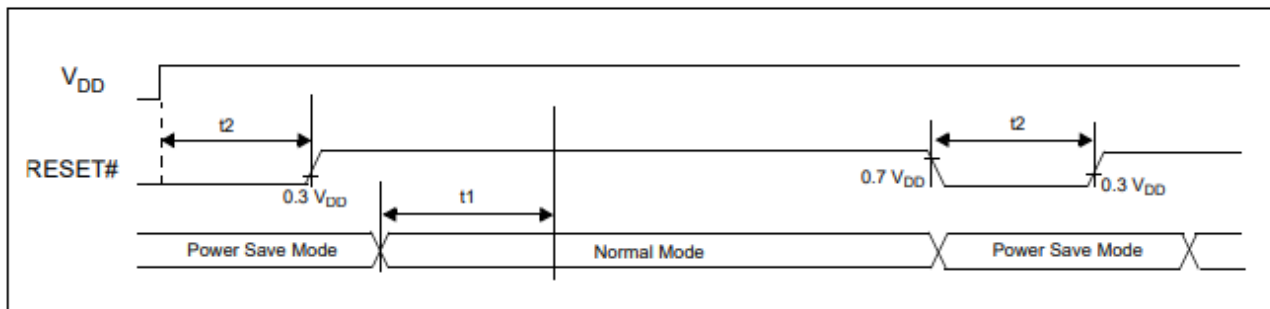
Indirect 8-bit Function Select:

A0	/WR	/RD	Comments
0	0	1	Command Write (register address)
1	0	1	Data (Parameter) Write
0	1	0	inhibit
1	1	1	Data (Parameter) Read

4.2.2 Reset Timing



Reset Timing When Using An External Oscillator



Reset Timing When Using Internal Oscillator With External Crystal

Figure 3

Symbol	Parameter	Min	Max	Units
t1	Oscillator stable delay	Note 1	-	ms
t2	Reset pulse duration	100(Note 2)	-	ns

Note:

1. When using an external oscillator, a delay is required following the rising edges of both RESET# and VDD to allow for system stabilization. This delay allows the clock used by the internal oscillator circuit to become stable before use. The delay time depends on a crystal. The S1D13709 must not be accessed before the oscillation circuit is stable.

When using the internal oscillator with an external crystal, a delay is required after exiting power save mode. For direct mode, writing REG[08h] bit 0 will exit power save mode and start the internal oscillator. For indirect mode, writing the SYSTEM SET command will exit power save mode and start the internal oscillator.

2. The S1D13709 requires a reset pulse of at least 100 ns after power-on in order to re-initialize its internal state. For maximum reliability, it is not recommended to apply a DC voltage to the LCD panel while the S1D13709 is reset. Turn off the LCD power supplies for at least one frame period after the start of the reset pulse.

Note that during the reset period the S1D13709 cannot receive commands. Commands to initialize the internal registers should be issued soon after a reset. During reset, the LCD drive signals FPDAT, LP and FR are halted.

For more information and details please refer to LCD controller (S1D13709) datasheet.

5. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		$\theta=0^{\circ}$ $\Phi=0^{\circ}$	-	250	-	Cd/m ²	1
Uniformity	$\triangle$ Bp			80%	-	-		1,2
Viewing Angle	θ_1 ($\phi=90^{\circ}$ or 270°)		Cr $\geq$ 10	-25 $\sim$ +60			Deg	3
	θ_2 ($\phi=0^{\circ}$ or 180°)			-45 $\sim$ +45				
Contrast Ratio	Cr		$\theta=0^{\circ}$ $\Phi=0^{\circ}$	-	300	-	-	4
Response Time	T _r			-	25	40	ms	5
	T _f			-	25	40	ms	
Color of CIE Coordinate	W	x		-	0.29	-	-	1,6
		y		-	0.31	-	-	
NTSC Ratio	S				50	-		

Note: The parameter may slightly change over temperature, driving voltage and materials.

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: $T_a=25^{\circ}\text{C}$.
- 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: reference Figure4

The luminance uniformity is calculated by using following formula.

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

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

spots

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

Note 3: reference Figure5

The definition of viewing angle:

Refer to the graph below marked by θ and ϕ

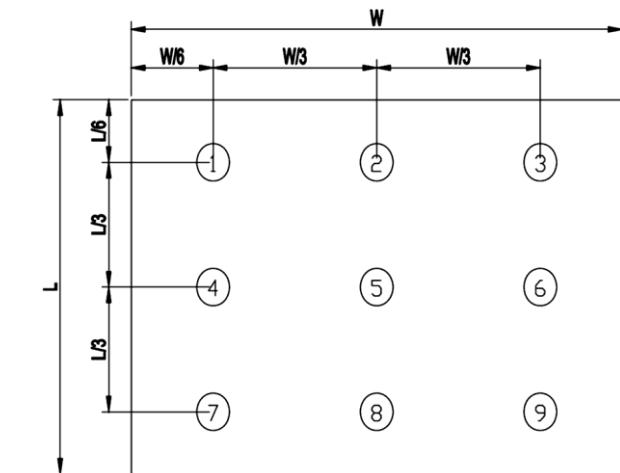


Figure 4

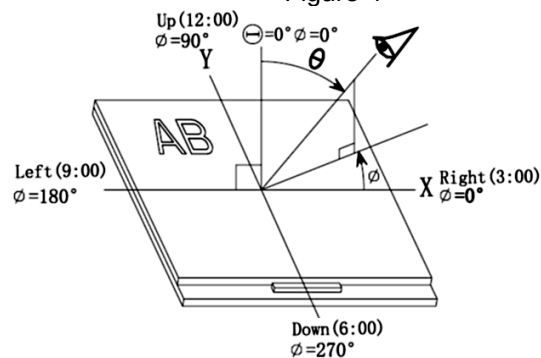


Figure 5

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

(Contrast Ratio is measured in optimum common electrode voltage)

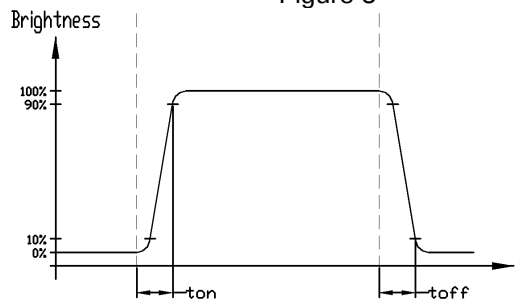


Figure 6

Note 5: reference Figure6

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: reference Figure7

Definition of Color of CIE Coordinate and NTSC Ratio.

Color gamut:

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

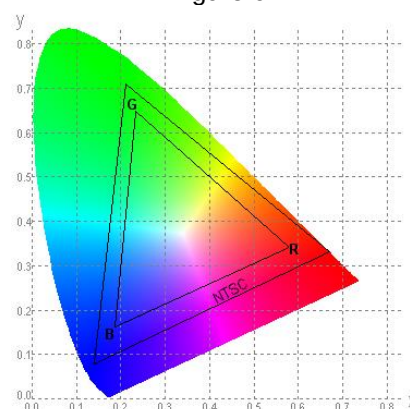


Figure 7

6. Function Specifications

6.1 Command Summary

Class	Direct Interface Address	Command	Register Description	Control Byte Value	No. of Bytes
System Control	8000h - 8007h	SYSTEM SET	Initializes device and display	40h	8
	8008h	POWER SAVE	Enters standby mode	53h	0
Display Control	8009h - 800Ah	DISP ON/OFF	Enables/disables display and display attributes	58h 59h	1
	800Bh - 8014h	SCROLL	Sets screen block start addresses and sizes	44h	10
	8015h - 8016h	CSRFORM	Sets cursor type	5Dh	2
	8017h	CSRDIR	Sets direction of cursor movement	4Ch - 4Fh	0
	8018h	OVLAY	Sets display overlay format	5Bh	1
	8019h - 801Ah	CGRAM ADR	Sets start address of character generator RAM	5Ch	2
	801Bh	HDOT SCR	Sets horizontal scroll position	5A	1
Drawing Control	801Ch - 801Dh	CSRW	Sets cursor address	46h	2
	801Eh - 801Fh	CSRR	Reads cursor address	47h	2
Display Control	8020h	GRAYSCALE	Sets the Grayscale depth (bpp)	60h	1
System Control	8000h - 8007h	SYSTEM SET	Initializes device and display	40h	8
	8008h	POWER SAVE	Enters standby mode	53h	0
ID	8030h	ID	Reads ID	61h	0
TFT-IF Control	8031h - 8033h	PLL SET	Initializes PLL	62h	3
	8034h	TFT-IF SET 1	Initializes TFT Interface	63h	1
	8035h - 804Ah	TFT-IF SET 2	Initializes TFT Interface	64h	22
Scroll Option	804Bh	HDOT SCR SYNC	Sets scroll option	65h	1
Color Palette	8063h - 8072h	PALETTE	Sets color palette	67h	16
Pin Drive	8073h	OUTDRIVE	Sets output pin drive	68h	1
Memory Control	0000h - 7FFFh	MEMWRITE	Writes to memory	42h	n/a
		MEMREAD	Reads from memory	43h	

For more information and details please refer to S1D13709 datasheet.

7. LCD Module Design and Handling Precautions

- Please ensure V0, VCOM is adjustable, to enable LCD module get the best contrast ratio under different temperatures, view angles and positions.
- Normally display quality should be judged under the best contrast ratio within viewable area. Unexpected display pattern may come out under abnormal contrast ratio.
- Never operate the LCD module exceed the absolute maximum ratings.
- Never apply signal to the LCD module without power supply.
- Keep signal line as short as possible to reduce external noise interference.
- IC chip (e.g. TAB or COG) is sensitive to light. Strong light might cause malfunction. Light sealing structure casing is recommended.
- Make sure there is enough space (with cushion) between case and LCD panel, to prevent external force passed on to the panel; otherwise that may cause damage to the LCD and degrade its display result.
- Avoid showing a display pattern on screen for a long time (continuous ON segment).
- LCD module reliability may be reduced by temperature shock.
- When storing and operating LCD module, avoids exposure to direct sunlight, high humidity, high or low temperature. They may damage or degrade the LCD module.
- Never leave LCD module in extreme condition (max./min storage/operate temperature) for more than 48hr.
- Recommend LCD module storage conditions is 0 C~40 C <80%RH.
- LCD module should be stored in the room without acid, alkali and harmful gas.
- Avoid dropping & violent shocking during transportation, and no excessive pressure press, moisture and sunlight.
- LCD module can be easily damaged by static electricity. Please maintain an optimum anti-static working environment to protect the LCD module. (eg. ground the soldering irons properly)
- Be sure to ground the body when handling LCD module.
- Only hold LCD module by its sides. Never hold LCD module by applying force on the heat seal or TAB.
- When soldering, control the temperature and duration avoid damaging the backlight guide or diffuser which might degrade the display result such as uneven display.
- Never let LCD module contact with corrosive liquids, which might cause damage to the backlight guide or the electric circuit of LCD module.
- Only clean LCD with a soft dry cloth, Isopropyl Alcohol or Ethyl Alcohol. Other solvents (e.g. water) may damage the LCD.
- Never add force to components of LCD module. It may cause invisible damage or degrade the module's reliability.
- When mounting LCD module, please make sure it is free from twisting, warping and bending.
- Do not add excessive force on surface of LCD, which may cause the display color change abnormally.
- LCD panel is made with glass. Any mechanical shock (e.g. dropping from high place) will damage the LCD module.

7. 液晶显示模块设计和使用须知

- 请注意 V0, VCOM 的设定, 以确保液晶显示模块在不同的使用温度下以及在不同的视角和位置观察模块显示, 均能达到最佳对比度, 请务必将应用电路上设置为对比度可调。
- 请注意液晶显示模块的显示品质判定是指在正常对比度下以及视窗(V.A)范围内进行的, 非正常对比度下液晶可能会出现非预期的显示不良, 应注意区分。
- 请勿在最大额定值以外使用液晶显示模块。
- 请勿在没有接通电源的条件下, 给液晶显示模块输送信号。
- 请尽可能缩短信号线的连接, 以避免对液晶显示模块的信号干扰。
- 集成电路因 IC 芯片(如 TAB 或 COG)对紫外线极为敏感, 强光环境下可能会引起液晶显示模块功能失效, 故应采用不透光的外壳。
- 请在液晶显示模块与外壳之间保留足够的空间(可使用衬垫), 以缓冲外力对液晶显示模块的损坏或因受力不均而产生的显示不匀等异常现象。
- 避免液晶显示屏在某一画面下长时间点亮, 否则有出现残影的风险; 请通过软件每隔一段时间改变一次画面。
- 液晶显示模块的可靠性可能因温度冲击而降低。
- 请勿在阳光直射、高湿、高温或低温下储存和使用液晶显示模块, 这将造成液晶显示模块的损坏或失效。
- 请勿在极限环境(最大/最小存储/工作温度)下使用或放置液晶显示模块超过 48 小时以上。
- 液晶显示模块建议存储条件为: 0 C~40 C <80%RH。
- 请勿让液晶显示模块存储于带有 酸性, 碱性, 有害气体环境之中。
- 在运输过程中, 请勿让液晶显示模块跌落与猛烈震动, 同时避免 异常挤压, 高湿度, 与阳光照射。
- 液晶显示模块极易受静电损坏, 请务必保证液晶显示模块在防静电的工作环境中使用或保存。(如: 烙铁正确接地, 等)
- 拿取液晶显示模块时需注意操作人员的接地情况。
- 请手持液晶显示模块的边沿取放模块, 防止热压纸或 TAB 部位受力。
- 焊接液晶模块时, 请注意控制烙铁的温度、焊接时间, 以免烫坏导光板或偏光片, 导致显示不匀等不良现象发生。
- 请勿使用洗板水等腐蚀性液体接触液晶模块, 以免腐蚀导光板或模块电路。
- 仅可使用柔软的干布, 异丙醇或乙醇清洁液晶屏表面, 其他任何溶剂(如: 水)都有可能损坏液晶模块。
- 请勿挤压液晶显示模块上的元器件, 以避免产生潜在的损坏或失效而影响产品可靠性。
- 装配液晶显示模块时, 请务必注意避免液晶显示模块的扭曲或变形。
- 请勿挤压液晶显示屏表面, 这将导致显示颜色的异常。
- 液晶屏由玻璃制作而成, 任何机械碰撞(如从高处跌落)均有可能损坏液晶显示模块。

- | | |
|---|--|
| <ul style="list-style-type: none">- Protective film is attached on LCD screen. Be careful when peeling off this protective film, since static electricity may be generated.- Polarizer on LCD gets scratched easily. If possible, do not remove LCD protective film until the last step of installation.- When peeling off protective film from LCD, static charge may cause abnormal display pattern. The symptom is normal, and it will turn back to normal in a short while.- LCD panel has sharp edges, please handle with care.- Never attempt to disassemble or rework LCD module.- If display panel is damaged and liquid crystal substance leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes promptly wash it off using soap and water. | <ul style="list-style-type: none">- 液晶屏表面带有保护膜，揭除保护膜时需要注意可能产生的静电。- 因液晶显示屏表面的偏光片极易划伤，安装完成之前请尽量不要揭下保护膜。- 请缓慢揭除保护膜，在此过程中液晶显示屏上可能会产生静电，此为正常情况，可在短时间内消失。
- 请注意避免被液晶显示屏的边缘割伤。- 请不要试图拆卸或改造液晶显示模块。- 当液晶显示屏出现破裂，内部液晶液体可能流出；相关液体不可吞吃，绝对不可接触嘴巴，如接触到皮肤或衣服，请使用肥皂与清水彻底清洗。 |
|---|--|

Warranty

This product has been manufactured to our company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed our company's acceptance inspection procedures.
- When the product is in CCFL models, CCFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
- We cannot accept responsibility for intellectual property of a third part, which may arise through the application of our product to our assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.

