3.99" 400*960 IPS ST7701S 262K 18 Bit RGB FPC Connector 40 Pin

ALP ELECTRONIX

- ST7701S is driven with 18 bit color depth.
- LCD can display 262K Colors (6R:6G:6B).
  - 18 Bit RGB Interface(VS, HS, DOTCLK, ENABLE, DB[17:0],Sync and DE mode)
- ST7701S has Lower Power Consumption.
- Display Colors (Color Mode)
  - Reduced color mode: 262K colors.
  - Reduced color mode: 65K colors.
  - Idle Mode: 8-color, RGB=(111).
- Programmable Pixel Color Format (Color Depth) for Various Display Data input Format
  - 18-bit/pixel: RGB=(666)
  - 16-bit/pixel: RGB=(565)
- Display Features
  - Programmable Partial Display Duty.
  - CABC for saving current consumption.
  - Color enhancement.
- SPI + RGB interface
  - Supports SPI for registers
- Normally black.
- IPS, all view direction.
- Power Supply
  - VDD: 2.5V - 3.6V
- Brightness: 350 cd/m^2.
- FPC Connector.

1 General Specifications

Feature		Specifications
Display Spec.	LCD type	3.99 inch
	Resolution (H*V)	400H x 960V
	Technology Type	a-Si
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	Normally Black
	Viewing Direction	ALL
	Gray Scale Inversion Direction	ALL
Mechanical Characteristics	Outline Dimensions (W x H x T) (mm)	42.5 x 102.08 x 1.9
	Active Area(mm)	39.18 x 94.032
	CTP View Area(mm)	/
	With /Without Touch screen	Without CTP
	Connector Type	Connector
	Backlight Type	LED
	Weight (g)	TBD
Electrical Characteristics	Display Interface	3SPI+18BIT RGB
	Touch Interface	I2C
	Number of color	262K
	Display Driver IC	ST7701S
	Touch Driver IC	-

Note 1: Viewing direction is following the data which measured by optics equipment.
Note 2: Requirements on Environmental Protection: RoHS
Note 3: LCM weight tolerance: +/- 5%

2 Electrical Characteristics

2.1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage	V_{DD}	-0.3	4.6	V
Operation Temperature	T_{opr}	-20	70	°C
Storage Temperature	T_{stg}	-30	80	°C

2.2 Driving TFT LCD Panel

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Operating Voltage	V_{DD}	2.5	3.3	3.6	V	-
Supply Current	I_{DD}	-	-	50	mA	V_{DD}=2.8V, Ta=25°C
Input Voltage	V_{IH}	0.8xV_{DD}	-	V_{DD}	V	
	V_{IL}	0	-	0.2xV_{DD}	V	
Input leakage current	I_{IL}	-1.0	-	1.0	μA	V_{DD}

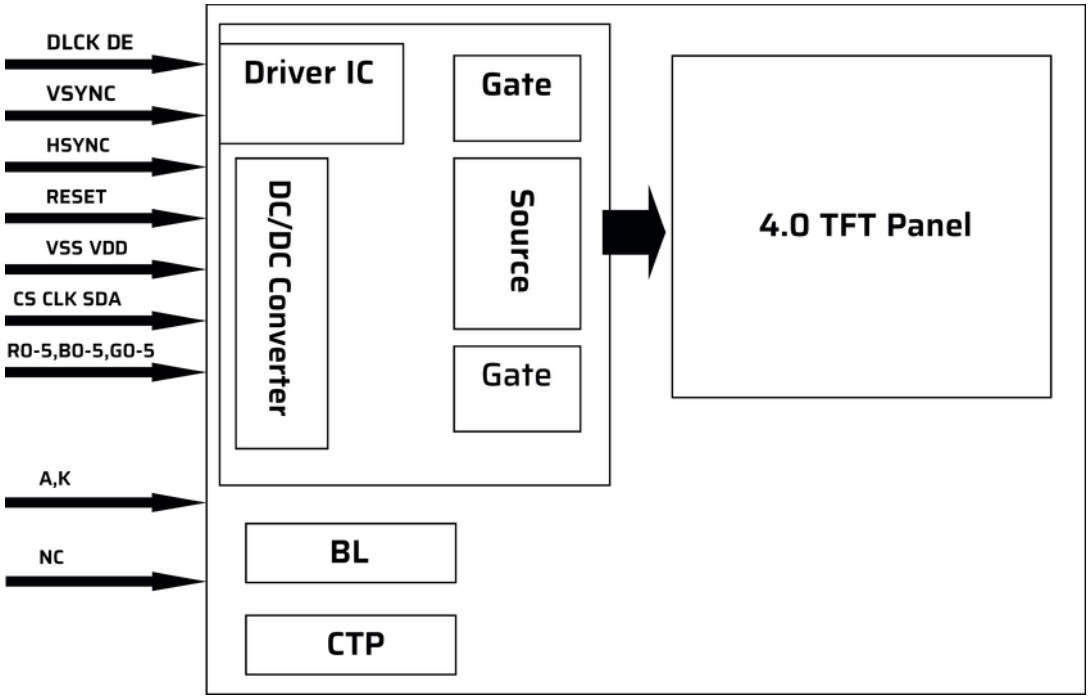
Note: Voltage greater than above may damage the module.
All voltages are specified relative to VSS=0V.

2.3 Backlight Unit

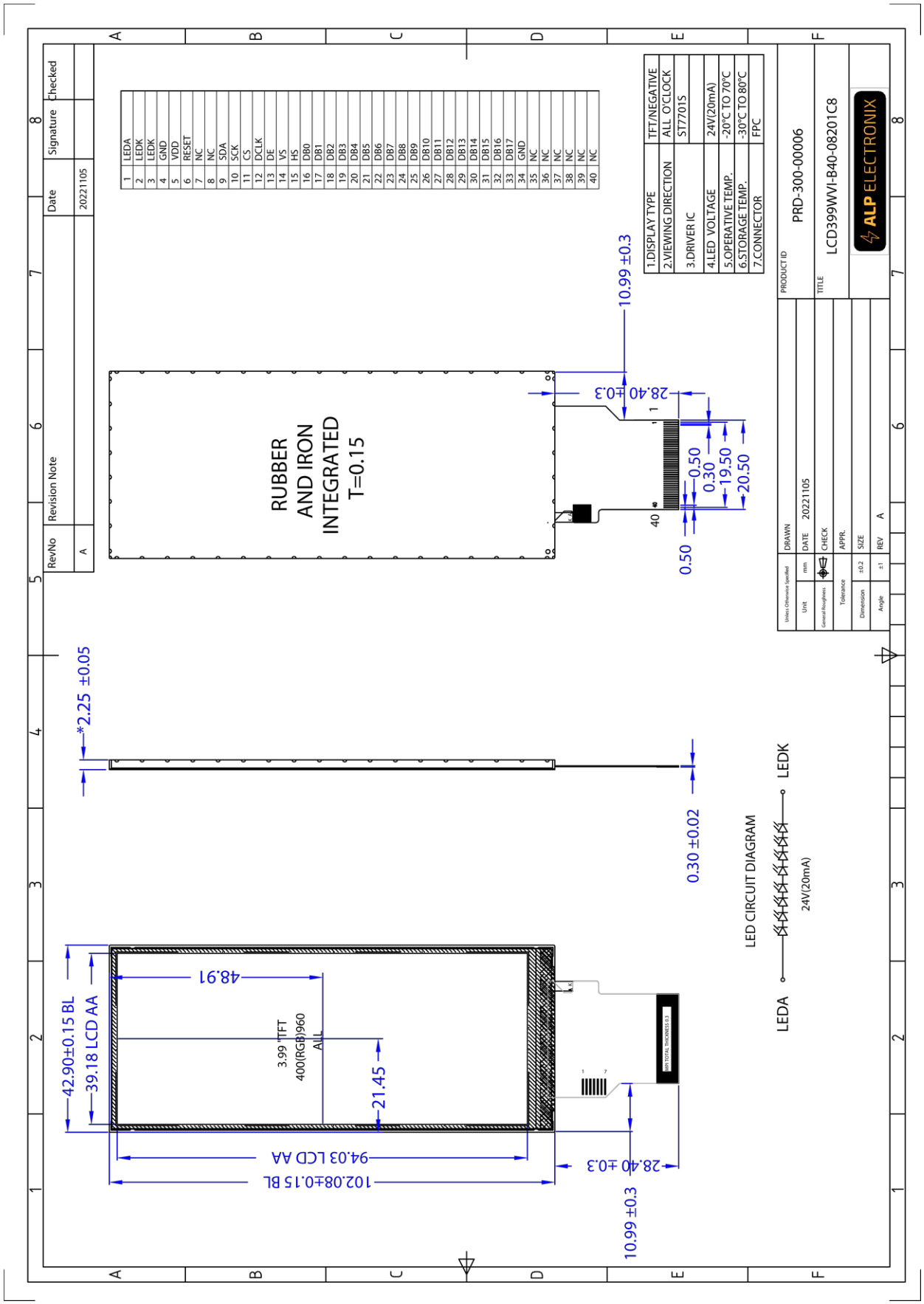
Parameter	Symbol	Min.	Typ.	Max.	Unit
Voltage for LED backlight	V_F	23.2	24	24.8	V
Current for LED backlight	I_F	--	20	-	mA
Power Consumption	P_C		480		mW
Connection Mode	-	-	8S	--	
LED number	-	/	8	-	pcs
LED Life Time	W_{BL}	25000			Hr

Note: Optical performance should be evaluated at Ta=25°C only .If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

2.4 Block Diagram



3 Mechanical Drawing



4 Pin Definition

Pin no.	Symbol	Description
1	LEDA	Backlight LED anode.
2	LEDK	Backlight LED cathode.
3	LEDK	Backlight LED cathode.
4	GND	Ground pin.
5	VDD	Power supply pin 3.3V.
6	$\overline{\text{RESET}}$	Reset pin. Active Low.
7	NC	No connection.
8	NC	No connection.
9	SDA	SPI data signal.
10	SCK	SPI clock signal.
11	$\overline{\text{CS}}$	SPI chip select signal. Active Low.
12	DCLK	RGB dot clock signal.
13	DE	RGB data enable signal.
14	VS	RGB frame synchronizing signal.
15	HS	RGB line synchronizing signal.
16-33	DB0~DB17	RGB data signal(DB0:BLUE LSB; DB5:BLUE MSB; DB6:GREEN LSB; DB11: GREEN, MSB; DB12: RED LSB; DB17: RED MSB).
34	GND	Ground pin.
35	NC	No Connection.
36	NC	No Connection.
37	NC	No Connection.
38	NC	No Connection.
39	NC	No Connection.
40	NC	No Connection.

Note 1:SPI+RGB interface

5 Optical Characteristics

Item		Symbol	Measuring Conditions	Min.	Typ.	Max.	Unit	Remark
Viewing Angle		θ_T	CR≥10 Center	-	85	-	Degree	Note 2
		θ_B		-	85	-		
		θ_L		-	85	-		
		θ_R		-	85	-		
Contrast Ratio		CR	Φ=0°	1000	1500	-	-	Note 1 Note 3
Response Time		T_{ON}	25°C	-	30	40	mS	Note 1 Note 4
		T_{OFF}			-	-		
Chromaticity	White	XW	Backlight is on	0.275	0.291	0.315	-	Note 1, Note 5
		YW		0.311	0.311	0.351	-	
	Red	XR		0.629	0.649	0.669	-	
		YR		0.294	0.314	0.334	-	
	Green	XG		0.243	0.263	0.283	-	
		YG		0.542	0.562	0.582	-	

	Blue	**XB**		0.117	0.137	0.157	-	
		YB		0.091	0.111	0.131	-	
Uniformity		**U**	-	80	-	-	%	Note 1 Note 6
NTSC		**-**	-	-	65	-	%	Note 5
Luminance		**L**		300	350	-	cd/m^2	Note 1 Note 7

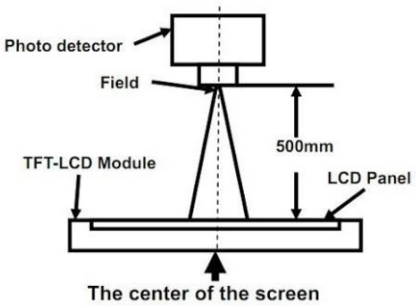
Test Conditions:

1. IF= 20mA (one channel),the ambient temperature is 25°C.

2. The test systems refer to Note 1 and Note 2.

Notes:

1. Definition of optical measurement system.
   The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo Detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

2. Definition of Viewing Angle:
   viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

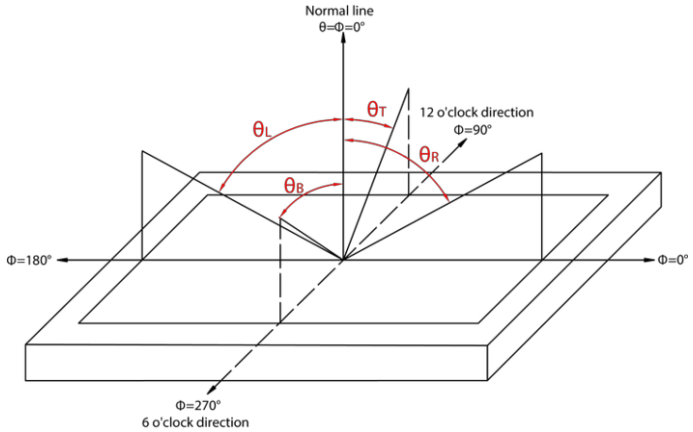


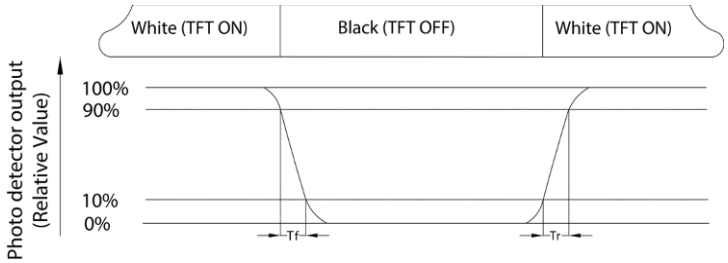
Fig. 1 Definition of viewing angle

3. Definition of Contrast Ratio (CR): measured at the center point of panel

$$Contrast\ Ratio\left(CR\right)=\frac{Luminance\ measured\ when\ LCD\ is\ on\ the\ White\ state}{Luminance\ measured\ when\ LCD\ is\ on\ the\ Black\ state}$$

"White state ":The state is that the LCD should be driven by Vwhite.
"Black state": The state is that the LCD should be driven by Vblack.
Vwhite: To be determined Vblack: To be determined.

4. Definition of Response Time:
   The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.



5. Definition of color chromaticity (CIE1931)
   Color coordinates measured at center point of LCD.

6. Definition of Luminance Uniformity
   Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.
   L=Active area length W=Active area width

$$Luminance\ Uniformity\ (U) = \frac{Lmin}{Lmax}$$

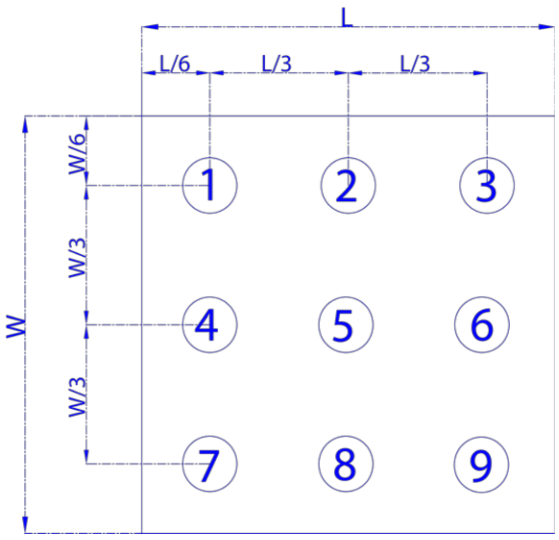


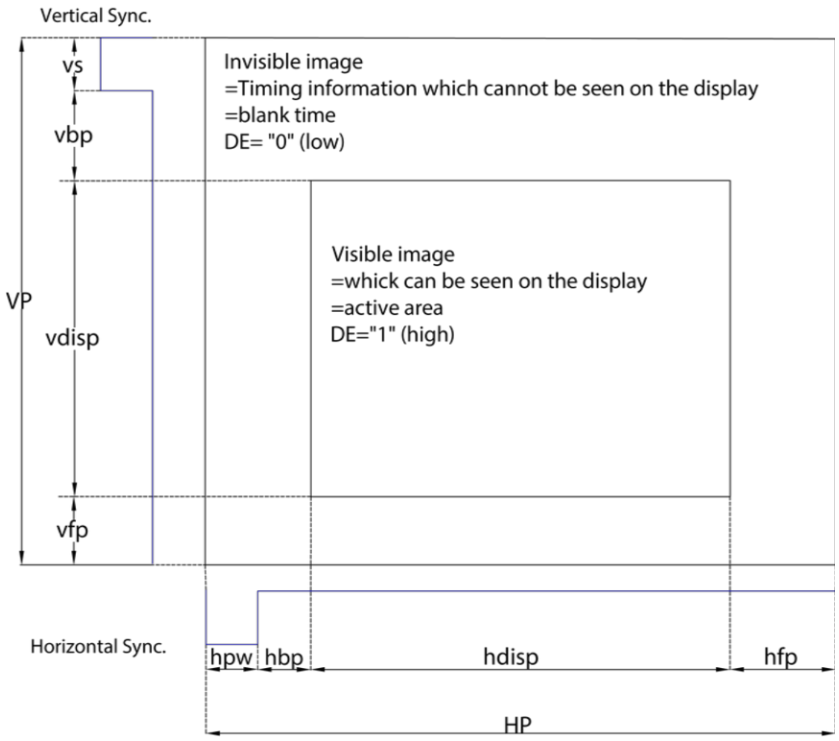
Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.
Lmin: The measured minimum luminance of all measurement position.

7. Definition of Luminance:
   Measure the luminance of white state at center point.

6 Interface Timing

6.1 System Bus Read/Write Characteristics.

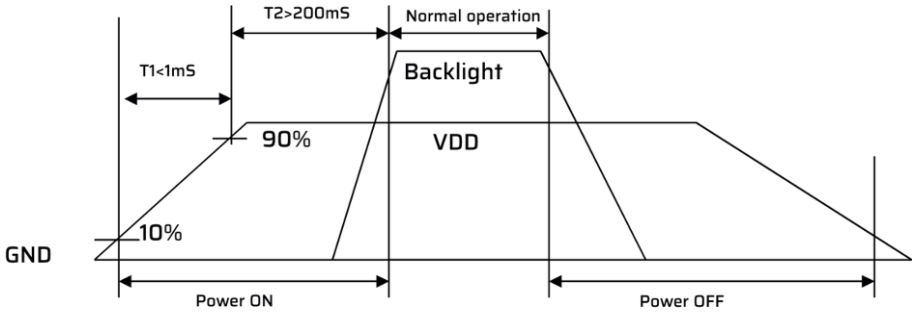


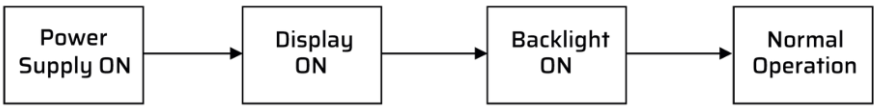
Please refer to the following table for the setting limitation of RGB interface signals.

Parameter	Symbol	Min	Typ.	Max.	Unit
Horizontal Sync. Width	**hpw**	1	-	255	Clock
Horizontal Sync. Back Porch	**hbp**	1	--	255	Clock
Horizontal Sync. Front Porch	**hfp**	1	--	-	Clock
Vertical Sync. Width	**vs**	1	--	254	Line
Vertical Sync. Back Porch	**vbp**	1	--	254	Line
Vertical Sync. Front Porch	**vfp**	2	--	--	Line

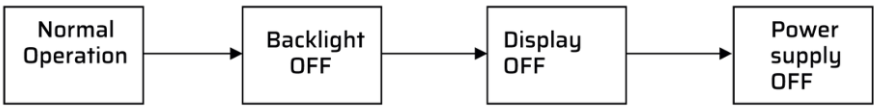
Note: Typical value are related to the setting frame rate is 60Hz.

6.2 Power ON/OFF Timing





Power ON sequence



Power OFF sequence

7 Environmental / Reliability Test

No.	Item	Condition	Time	Remarks
1	**High temp. Storage**	80°C	240 hrs	Note 1 IEC60068-2-2, GB2423. 2-89
2	**High temp. Operating**	70°C	240 hrs	Note 2 IEC60068-2-1
3	**Low temp. Storage**	-30°C	240 hrs	IEC60068-2-2 GB2423. 2-89
4	**Low temp. Operating**	-20°C	240 hrs	IEC60068-2-1 GB/T2423.1-89
5	**Humidity**	40°C / 90%RH	160 hrs	IEC60068-2-3 GB/T2423.3-2006
6	**Thermal Shock(Non-operation)**	-30°C ← +80°C (0.5 hour ↔ 0.5 hour)	30 cycles	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	**Electro Static Discharge (Operation)**	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5 times; (Environment: 15°C ~ 35°C, 30% ~ 60%, 86Kpa ~ 106Kpa)	-	IEC61000-4-2 GB/T17626.2-1998
8	**Vibration (Non-operation)**	Frequency range: 10~55Hz, Stroke: 1.mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X, Y, Z. (package condition)	-	IEC60068-2-6 GB/T2423.5-1995
9	**Shock (Non-operation)**	60G 6ms, ± X, ±Y, ± Z 3 times for each direction	6mS	IEC60068-2-27 GB/T2423.5-1995
10	**Package Drop Test**	Height: 80 cm, 1 corner, 3 edges, 6 surfaces	-	IEC60068-2-32 GB/T2423.8-1995

Remark:

1.The test samples should be applied to only one test item.

2.Sample size for each test item is 1~10pcs.

3.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

8 Precautions For Use of LCD Modules

8.1 Handling Precautions

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it 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.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
    - Isopropyl alcohol
    - Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

- Do not attempt to disassemble the LCD Module.
- If the logic circuit power is off, do not apply the input signals.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- Be sure to ground the body when handling the LCD Modules.
- Tools required for assembly, such as soldering irons, must be properly ground.
- To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- The LCD Module is coated with a film to protect the display surface. Be careful when peeling off the protective film since static electricity may be generated.

8.2 Storage precautions

- When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:
- The LCD modules should be stored in the room without acid, alkali and harmful gas.

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9 Revision History

Revision	Details
1.0	Initial Release – 01.01.2023

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