Crystalfontz

CHARACTER LCD MODULE DATASHEET

Datasheet Release Date 2018-03-21
for
CFAH1602Y-NYG-ET

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Contents

1. General Information

Datasheet Revision History
Datasheet Release: **2018-03-21** Datasheet for the CFAH1602Y-NYG-ET character LCD display module.

Product Change Notifications
You can check for or subscribe to Part Change Notices for this display module on our website.

Variations
Slight variations between lots are normal (e.g., contrast, color, or intensity).

Volatility
This display module has volatile memory.

Disclaimer
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2. Module Description

This is a 16 character by 2-lines LCD display with no backlight. This display has a built-in Sunplus SPLC780D controller.

Please see Sunplus SPLC780D LCD Controller Datasheet for further reference.

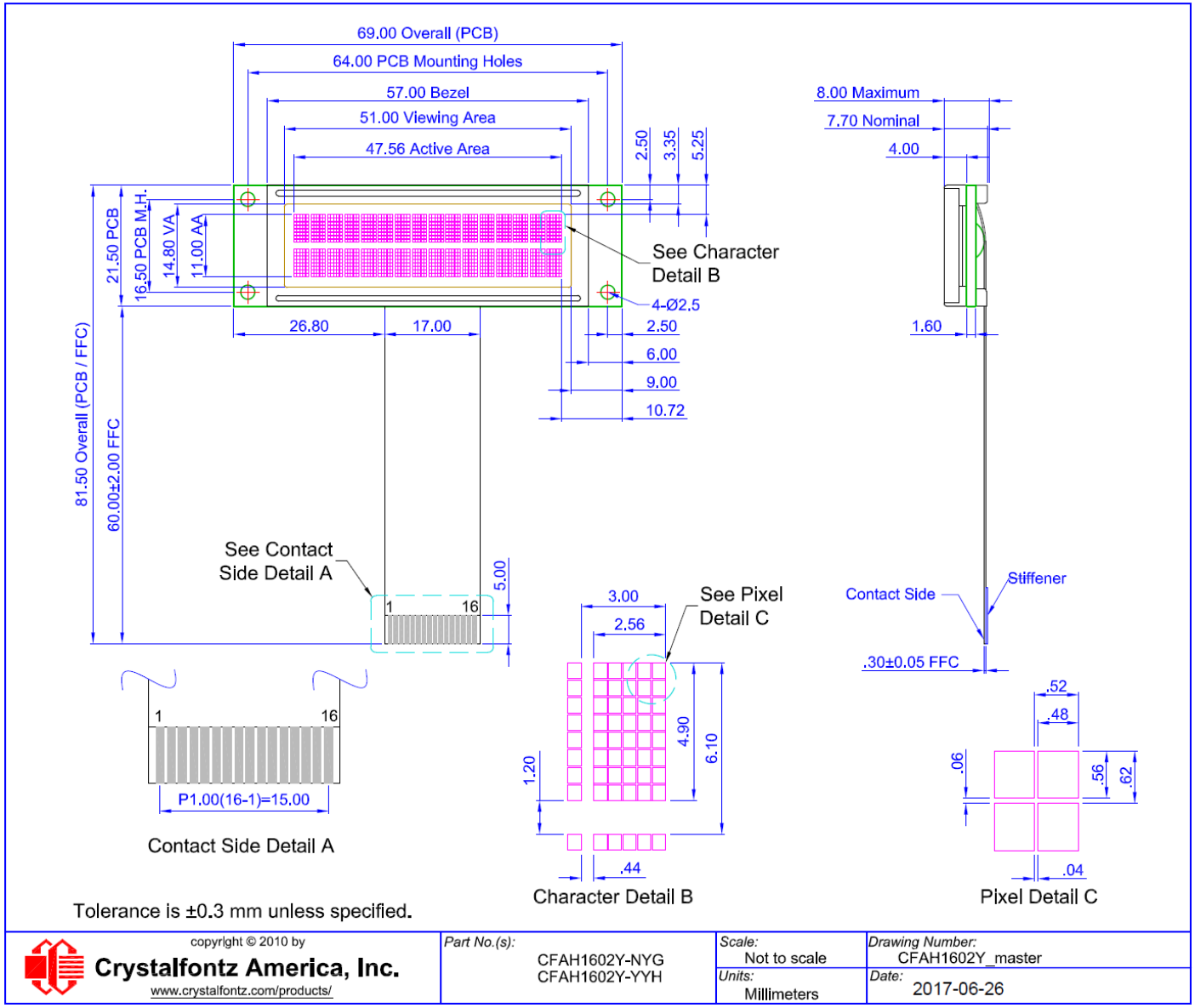
3. Features

- Built-in Controller: SPLC780D (or equivalent)
- STN Positive, Yellow-green, Reflective Mode
- +5v Power Supply
- Viewing Direction: 6 o'clock
- 1/16 Duty
- Temperature Operation: -20°C to +70°C
- Storage Operation: -30°C to +80°C
- Interface: 4-Bit or 8-Bit Parallel

4. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Width and Height	69.0 (W) x 21.5 (H) x 8.0 (D)	2.717 (W) x 0.846 (H) x 0.315 (D)
FFC Dimension	60.0 (W) x 17.0 (H) x 0.3 (D)	2.362 (W) x 0.669 (H) x 0.001 (D)
FFC Pitch	1.0	0.039
Viewing Area	51.0 (W) x 14.8 (H)	2.008 (W) x 0.583 (H)
Active Area	47.56 (W) x 11.0 (H)	1.872 (W) x 0.433 (H)
Character Size	2.56 (W) x 4.90 (H)	0.101 (W) x 0.193 (H)
Character Pitch	3.00 (W) x 6.10 (H)	0.118 (W) x 0.240 (H)
Dot Size	0.48 (W) x 0.56 (H)	0.019 (W) x 0.022 (H)
Dot Pitch	0.52 (W) x 0.62 (H)	0.020 (W) x 0.024 (H)
Weight (Typical)	13 grams	0.46 ounces

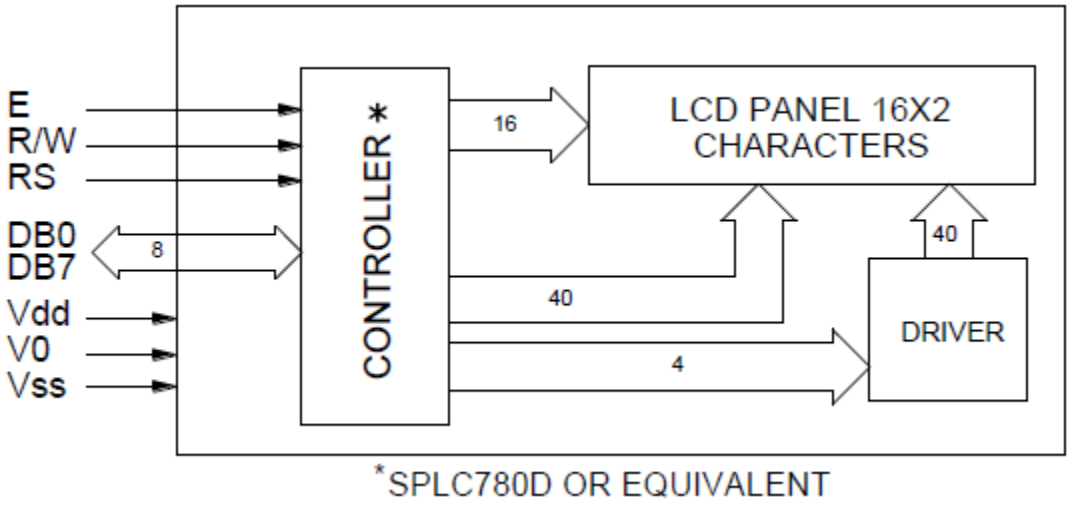
5. Mechanical Drawing



6. Interface Pin Function

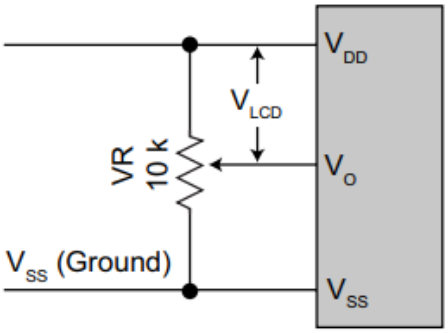
Pin No.	Symbol	Level	Function
1	V_{SS}	0v	Ground
2	V_{DD}	5.0v	Supply Voltage for Logic
3	V_0	(variable)	Supply Voltage for LCD
4	RS	H/L	H: Data L: Instruction Code
5	R/W	H/L	H: Read L: Write
6	E	H, H→L	Chip Enable Signal
7	DB0	H/L	Data Bus Line
8	DB1	H/L	Data Bus Line
9	DB2	H/L	Data Bus Line
10	DB3	H/L	Data Bus Line
11	DB4	H/L	Data Bus Line
12	DB5	H/L	Data Bus Line
13	DB6	H/L	Data Bus Line
14	DB7	H/L	Data Bus Line
15	NC	-	No Connection
16	NC	-	No Connection

7. System Block Diagram



8. Typical V_O Connections for Display Contrast

Adjust V_O to +1v (V_{LCD} = +4v) as an initial setting. When the module is operational, readjust V_O for optimal display appearance.



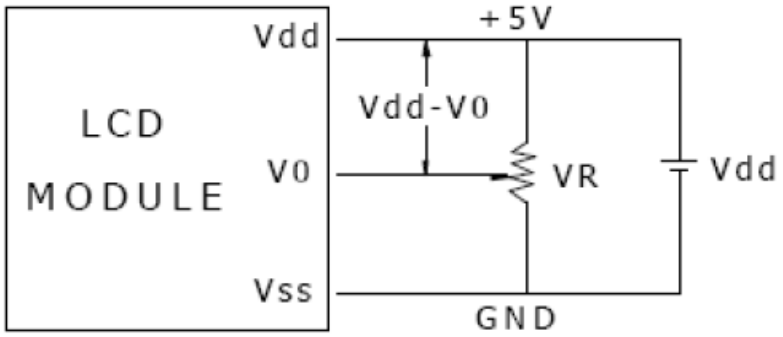
We recommend allowing field adjustment of V_O for all designs. The optimal value for V_O will change with temperature, variations in V_{DD}, and viewing angle. V_O will also vary module-to-module and batch-to-batch due to normal manufacturing variations.

Ideally, adjustments to V_O should be available to the end user so each user can adjust the display to the optimal contrast for their required viewing conditions. At a minimum, your design should allow V_O to be adjusted as part of your product's final test.

Although a potentiometer is shown as a typical connection, V_O can be driven by your microcontroller, either by using a DAC or a filtered PWM. Displays that require V_O to be negative may need a level-shifting circuit. Please do not hesitate to contact Crystalfontz application support for design assistance on your application.

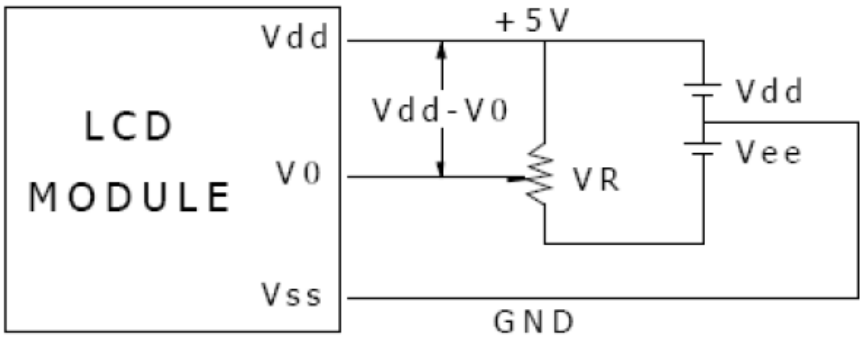
9. Power Supply

9.1. Single Supply Voltage



Vdd-V0: LCD Driving Voltage
VR: 10K - 20K

9.2. Dual Supply Voltage



Vdd-V0: LCD Driving Voltage
VR: 10K - 20K

10. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply Voltage for Logic	V_{DD} -V_{SS}	-0.3	-	7.0	V	(1)(2)
Supply Voltage for LCD	V_{DD} -V_O	V_{DD}-13.5	-	V_{DD}-0	V	(1)(2)
Input Voltage	V_I	-0.3	-	V_{DD}+0.3	V	-
Operating Temperature	T_{OP}	-20	-	+70	°C	-
Storage Temperature	T_{ST}	-30	-	+80	°C	-

Notes:

(1) These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage.

(2) Functional operation should be restricted to the limits in the Electrical Characteristics table below.

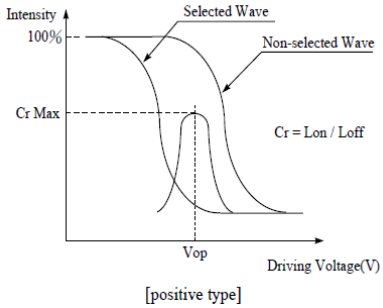
11. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD} -V_{SS}	-	4.5	5.0	5.5	V
Supply Voltage for LCD	V_{DD} -V_O	Ta=25°C	3.4	3.8	4.2	V
High-level Input	V_{IH}	-	0.7 V_{DD}	-	V_{DD}	V
Low-level Input	V_{IL}	-	V_{SS}	-	0.3 V_{DD}	V
Supply Current	I_{DD}	V_{DD} = 5V	0.5	1.2	1.5	mA

12. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V)θ	CR≧2	-20	-	35	deg
	(H)φ	CR≧2	-30	-	30	deg
Contrast Ratio	CR	-	-	3	-	-
Response Time	T rise	-	-	-	250	ms
	T fall	-	-	-	250	ms

Definition of Operating Voltage (VOP)

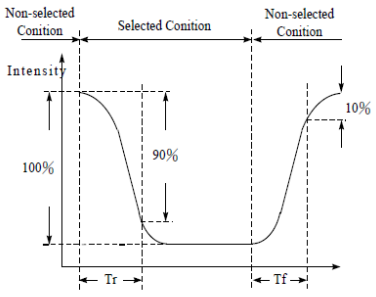


[positive type]

Conditions:

Operative Voltage: V_{OP}

Definition of Response Time (Tr, Tf)



[positive type]

Conditions:

Viewing Angle (θ, φ): 0°, 0°

Frame Frequency: 64 Hz

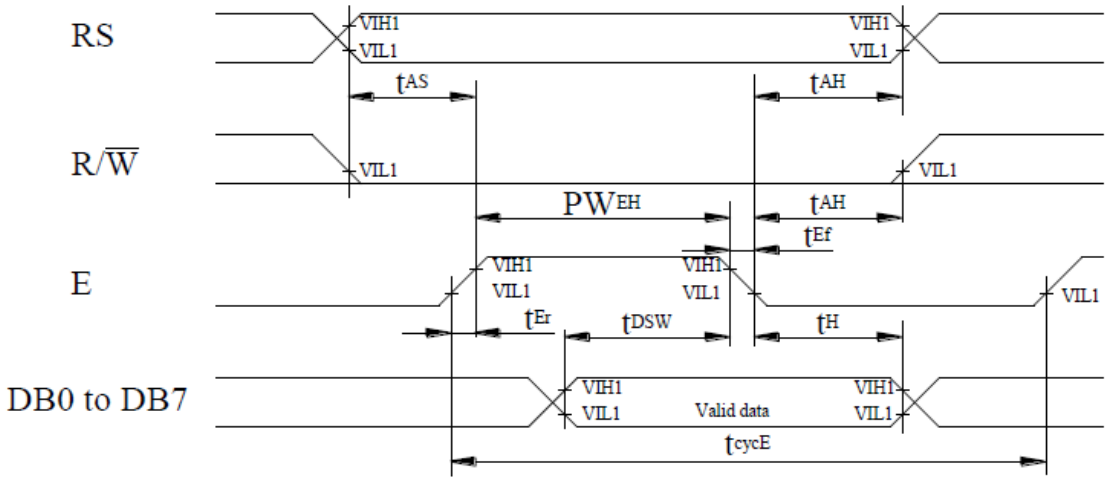
Driving Waveform: 1/N Duty, 1/a Bias

13. Instruction Table

Instruction	Instruction Code										Description	Execution Time (F_{OSC}=270Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write “OOH” to DDRAM address to “OOH” from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to “00H” from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39µs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39µs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39µs
Function Set	0	0	0	0	1	D/L	N	F	-	-	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line) and, display font type (F:5×11 dots/5×8 dots)	39µs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39µs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39µs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0µs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43µs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43µs

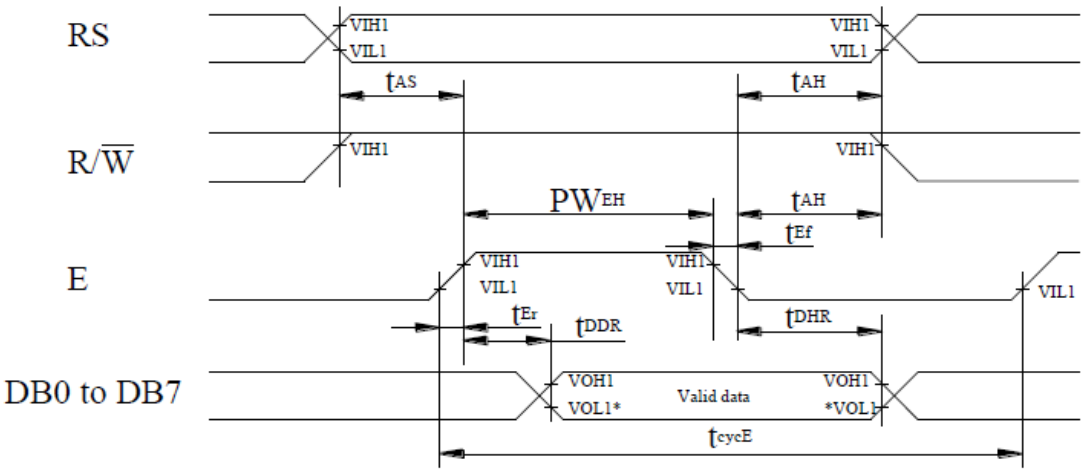
14. Timing Characteristics

14.1. Write Operation



Item	Symbol	Min	Typ	Max	Unit
Enable Cycle Time	t_{CYCE}	1200	-	-	ns
Enable Pulse Width (high level)	PW_{EH}	140	-	-	ns
Enable Rise/Fall Time	t_{Er},t_{Ef}	-	-	25	ns
Address Set-Up Time (RS, R/W to E)	t_{AS}	0	-	-	ns
Address Hold Time	t_{AH}	10	-	-	ns
Data Set-Up Time	t_{DSW}	40	-	-	ns
Data Hold Time	t_{H}	10	-	-	ns

14.2. Read Operation

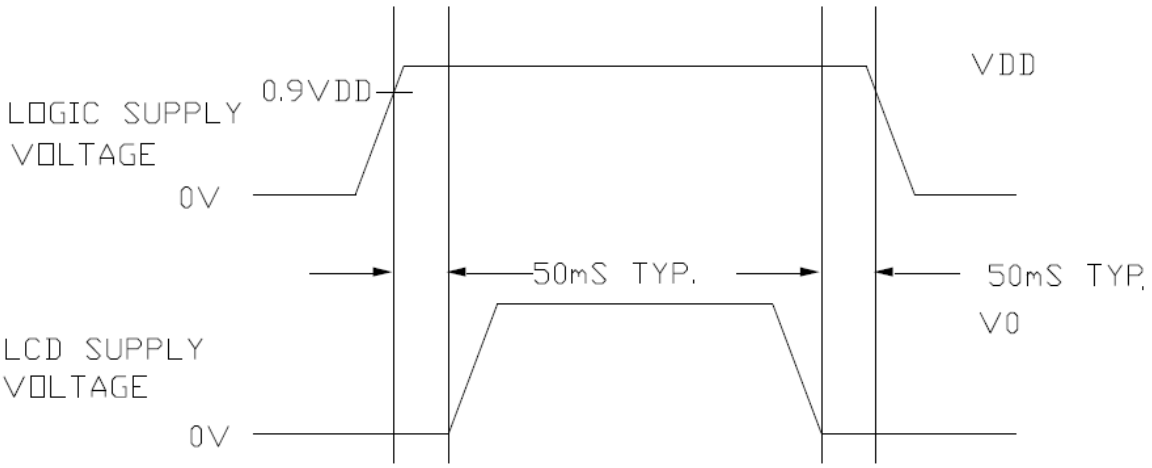


NOTE: VOL1 is assumed to be 0.8V at 2 MHz operation.

Item	Symbol	Min	Typ	Max	Unit
Enable Cycle Time	t_{CYCE}	1200	-	-	ns
Enable Pulse Width (high level)	PW_{EH}	140	-	-	ns
Enable Rise/Fall Time	t_{Er},t_{Ef}	-	-	25	ns
Address Set-Up Time (RS, R/W to E)	t_{AS}	0	-	-	ns
Address Hold Time	t_{AH}	10	-	-	ns
Data Delay Time	t_{DDR}	-	-	100	ns
Data Hold Time	t_H	10	-	-	ns

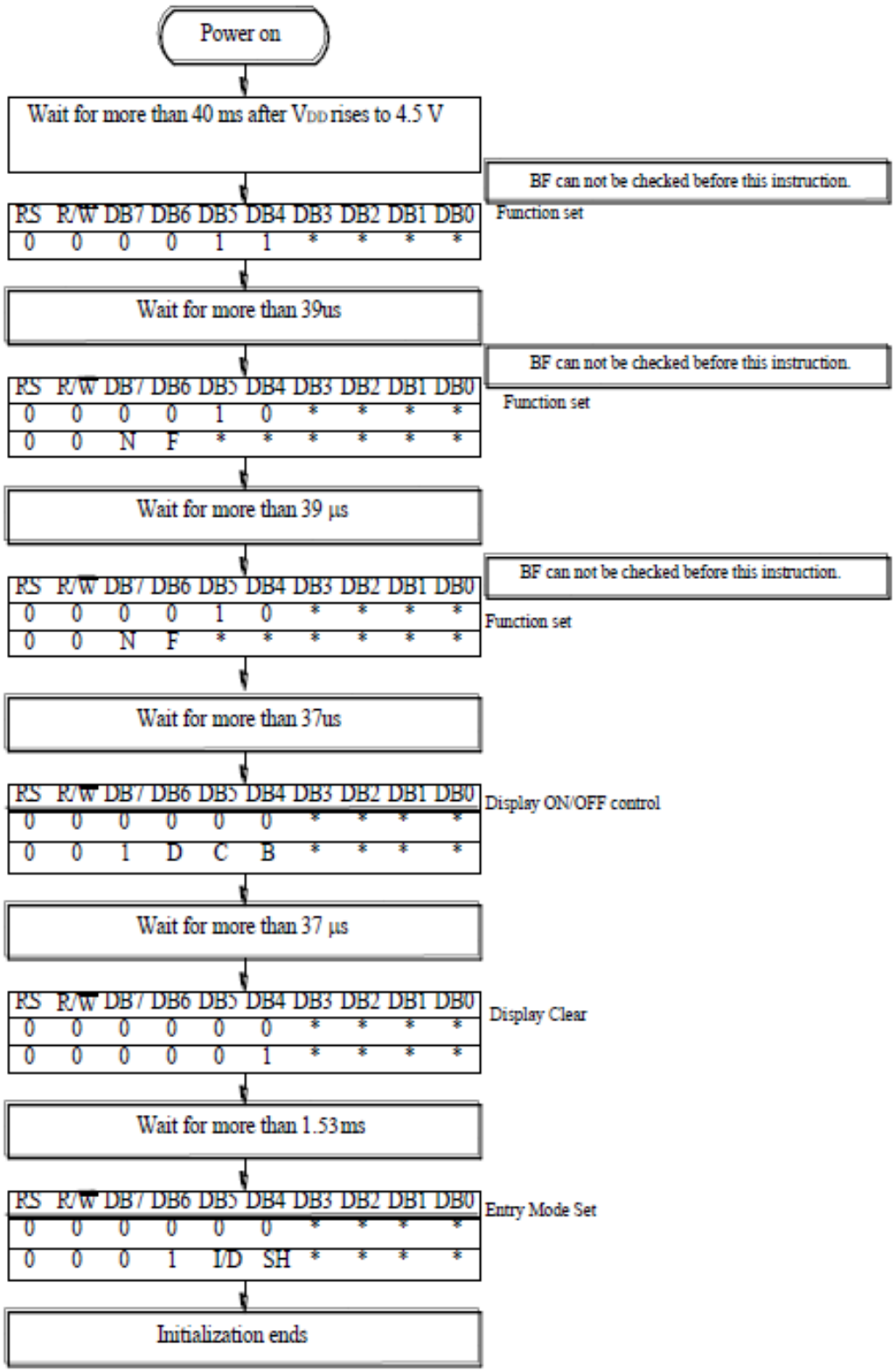
14.3. Timing Diagram of V_{DD} Against V_O

Power on sequence shall meet the requirement of the timing diagram of V_{DD} against V_O.

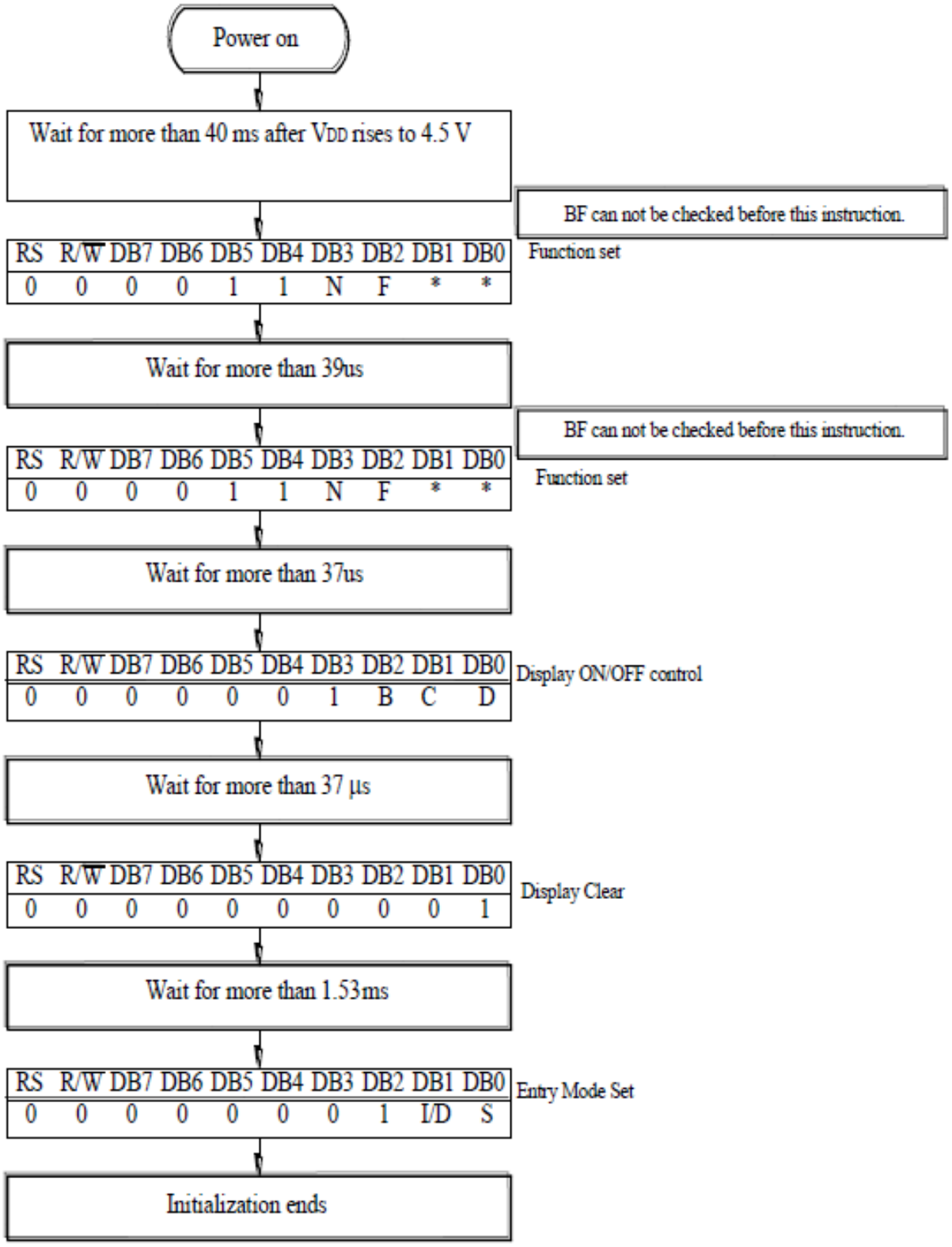


15. Initializing the LCM

15.1. 4-Bit Interface



15.2. 8-Bit Interface



16. Function Description

The LCD display module has a built-in LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU. The DR temporarily stores data to be written or read from DDRAM or CGRAM. When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

RS	R/W	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB7)
1	0	Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM)
1	1	Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR)

Busy Flag (BF)

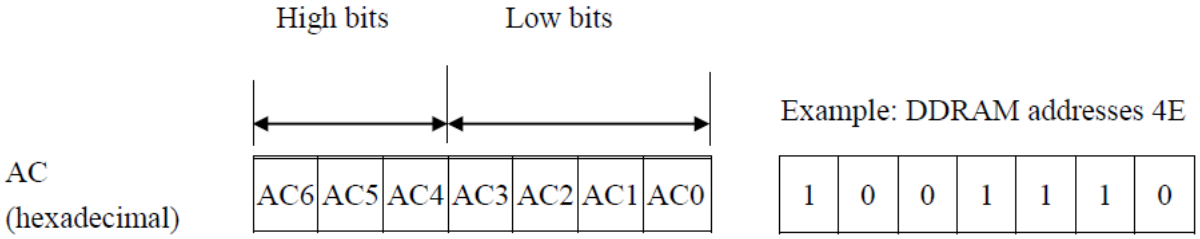
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM.

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80×8 bits or 80 characters. The figure below shows the relationship between DDRAM addresses and positions on the liquid crystal display.



Display Position DDRAM Address

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

2-Line by 16-Character Display

Character Generator ROM (CGROM)

The CGROM generates 5×8 dot or 5×10 dot character patterns from 8-bit character codes.

Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program. For 5×8 dots, eight-character patterns can be written, and for 5×10 dots, four-character patterns can be written; see section 16, CGROM.

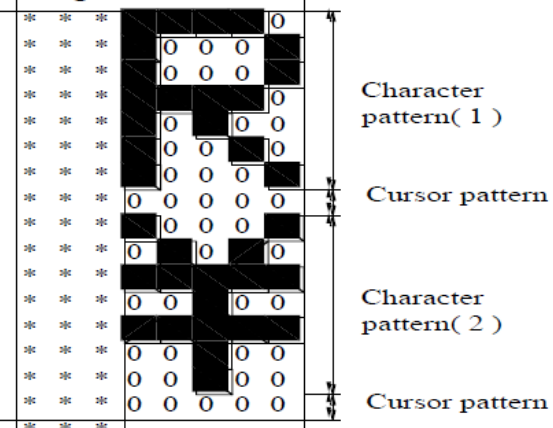
Write into DDRAM the character code at the addresses shown in the left column of Table 1, to show the character patterns stored in CGRAM.

Relationship between CGRAM Addresses, Character Codes (DDRAM), and Character Patterns

Table 1:

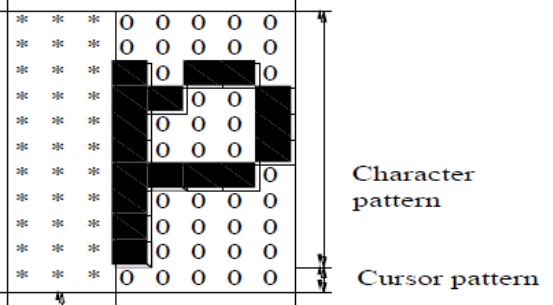
5x8 Dot Character Patterns

Character Codes (DDRAM data)	CGRAM Address	Character Patterns (CGRAM data)
7 6 5 4 3 2 1 0 High Low	5 4 3 2 1 0 High Low	7 6 5 4 3 2 1 0 High Low
0 0 0 0 * 0 0 0	0 0 0	0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1
0 0 0 0 * 0 0 1	0 0 1	0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1
0 0 0 0 * 1 1 1	1 1 1	1 0 0 1 0 1 1 1 0 1 1 1



5x10 Dot Character Patterns

Character Codes (DDRAM data)	CGRAM Address	Character Patterns (CGRAM data)
7 6 5 4 3 2 1 0 High Low	5 4 3 2 1 0 High Low	7 6 5 4 3 2 1 0 High Low
0 0 0 0 * 0 0 0	0 0 0 0 0 0 0 1 0 0 1 0 0 0 1 1 0 1 0 0 0 1 0 1 0 1 1 0 0 1 1 1 1 0 0 0 1 0 0 1 1 0 1 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	1 1 1 1	



: " High "

17. Character Generator ROM (CGROM)

Upper 4 bit / Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)																
LLLH	CG RAM (2)															
LLHL	CG RAM (3)															
LLHH	CG RAM (4)															
LHLL	CG RAM (5)															
LHLH	CG RAM (6)															
LHHL	CG RAM (7)															
LHHH	CG RAM (8)															
HLLL	CG RAM (1)															
HLLH	CG RAM (2)															
HLHL	CG RAM (3)															
HLHH	CG RAM (4)															
HHLL	CG RAM (5)															
HHLH	CG RAM (6)															
HHHL	CG RAM (7)															
HHHH	CG RAM (8)															

18. LCD Module Precautions

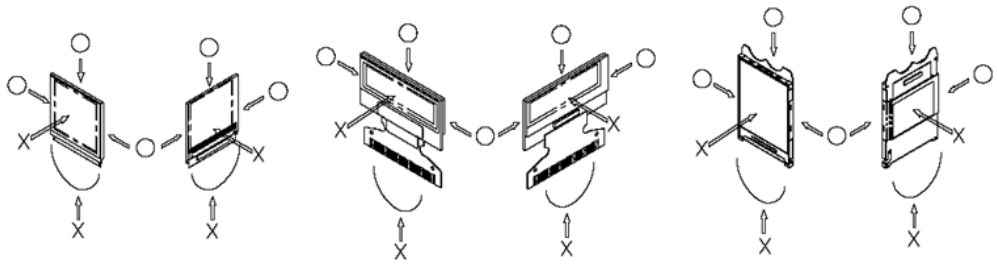
The precautions below should be followed when using LCD modules to help ensure personal safety, module performance, and compliance of environmental regulations.

18.1. Modules

- Avoid applying excessive shocks to module or making any alterations or modifications to it.
- Do not make extra holes on the printed circuit board, modify its shape or change the components of LCD display module.
- Do not disassemble the LCD display module.
- Do not operate the LCD display module above the absolute maximum rating.
- Do not drop, bend or twist the LCD display module.
- Soldering: only to the I/O terminals.
- Store in an anti-static electricity container and clean environment.
- It is common to use the "screen saver" to extend the lifetime of the LCD display module.
  - Do not use the fixed information for long periods of time in real application.
  - Do not use fixed information in LCD panel for long periods of time to extend "screen burn" effect time.
- Crystalfontz has the right to change the passive components, including R3, R6 & backlight adjust resistors. (Resistors, capacitors and other passive components will have different appearance and color caused by the different supplier.)
- Crystalfontz have the right to change the PCB Rev. (In order to satisfy the supplying stability, management optimization and the best product performance, etc., under the premise of not affecting the electrical characteristics and external dimensions, Crystalfontz has the right to modify the version.).

18.2. Handling Precautions

- Since the display panel is made of glass, do not apply mechanical impacts such as dropping from a high position.
- If the display panel is accidently broken, and the internal organic substance leaks out, be careful not to inhale or touch the organic substance.
- If pressure is applied to the display surface or its neighborhood of the LCD display module, the cell structure may be damaged, so be careful not to apply pressure to these sections.
- The polarizer covering the surface of the LCD display module is soft and can be easily scratched. Please be careful when handling the LCD display module.
- Clean the surface of the polarizer covering the LCD display module if it becomes soiled using following adhesion tape.
  - Scotch Mending Tape No. 810 or an equivalent
  - Never breathe the soiled surface or wipe the surface using a cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
  - The following liquids/solvents may spoil the polarizer:
    - Water
    - Ketone
    - Aromatic Solvents
- Hold the LCD display module very carefully when placing the LCD display module into the system housing.
- Do not apply excessive stress or pressure to the LCD display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, be sure to secure the sufficient rigidity for the outer cases.



- Do not apply stress to the LSI chips and the surrounding molded sections.
- Do not disassemble or modify the LCD display module.
- Do not apply input signals while the logic power is off.
- Pay sufficient attention to the working environments when handing the LCD display module to prevent occurrence of element breakage accidents by static electricity.
  - Be sure to make human body grounding when handling LCD display modules.
  - Be sure to ground tools to use for assembly such as soldering irons.
  - To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
  - Protective film is being applied to the surface of the display panel of the LCD display module. Be careful since static electricity may be generated when exfoliating the protective film.
- Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the LCD display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after the film has been removed. In such a case, remove the residue material by the method discussed above.
- If electric current is applied when the LCD display module is being dewed or when it is placed under high humidity environments, the electrodes may become corroded. If this happens proceed with caution when handling the LCD display module.

18.3. Storage Precautions

- When storing the LCD display modules put them in static electricity preventive bags to avoid exposure to direct sunlight and fluorescent lamps. Also avoid high temperature and high humidity environments and low temperatures (less than 0°C) environments. (We recommend you store these modules in the packaged state when they were shipped from Crystalfontz). Be careful not to let water drops adhere to the packages or bags, and do not let dew gather on them.
- If electric current is applied when water drops are adhering to the surface of the LCD display module the LCD display module may have become dewed. If a dewed LCD display module is placed under high humidity environments it may cause the electrodes to become corroded. If this happens proceed with caution when handling the LCD display module.

18.4. Designing Precautions

- The absolute maximum ratings are the ratings that cannot be exceeded for LCD display module. If these values are exceeded, panel damage may happen.
- To prevent occurrence of malfunctioning by noise pay attention to satisfy the V_{IL} and V_{IH} specifications and, at the same time, to make the signal line cable as short as possible.
- We recommend that you install excess current preventive unit (fuses, etc.) to the power circuit (V_{DD}). (Recommend value: 0.5A)
- Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
- As for EMI, take necessary measures on the equipment side.
- When fastening the LCD display module, fasten the external plastic housing section.
- If the power supply to the LCD display module is forcibly shut down, by such errors as taking out the main battery while the LCD display panel is in operation, we cannot guarantee the quality of this LCD display module.
  - Connection (contact) to any other potential than the above may lead to rupture of the IC.

18.5. Disposing Precautions

- Request the qualified companies to handle the industrial wastes when disposing of the LCD display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.

18.6. Other Precautions

- When an LCD display module is operated for a long period of time with a fixed pattern, the fixed pattern may remain as an after image or a slight contrast deviation may occur.
  - If the operation is interrupted and left unused for a while, normal state can be restored.

  - This will not cause a problem in the reliability of the module.
- To protect the LCD display module from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the LCD display modules.
  - Pins and electrodes
  - Pattern layouts such as the TCP & FPC
- With this LCD display module, the LCD driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this LCD driver is exposed to light, malfunctioning may occur.
  - Design the product and installation method so that the LCD driver may be shielded from light in actual usage.
  - Design the product and installation method so that the LCD driver may be shielded from light during the inspection processes.
- Although this LCD display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. Therefore, it is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- We recommend that you construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data), to cope with catastrophic noise.
- Resistors, capacitors, and other passive components will have different appearance and color caused by the different supplier.
- Crystalfontz has the right to upgrade and modify the product function.
- The limitation of FPC bending: