Specification for LCD

AMC1602AR-B-Y6WFDY-SPI

Revision O

A	Orient Display
MC	Character Display
1602	Character x Lines 16 x 2
AR	Module Dimension 80.0x36.0x14.0mm
B	COB Type
Y	STN Positive Yellow Green
6	6 o'clock viewing angle
W	Top: -20~+70°C; Tstr: -30~+80°C
F	Transflective
DY	Yellow-Green LED Backlight
/	Controller AC780S Or Compatible
/	Serial SPI Interface

DOCUMENT REVISION HISTORY:

DATE	PAGE	DESCRIPTION
2013.2	-	First release

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AMC1602A-SPI

Contents

1. Module Classification Information

1	Brand：ORIENT DISPLAY	
2	Display Type：C→ Character Type, G→ Graphic Type, NONE→ Custom-made	
3	Display Font：Characters X Lines / Rows X Columns /Others	
4	Model serials no.	
5	RoHS compliant: R→YES　NONE→ NO	
6	IC Package Type：	M→ SMT Type B→ COB Type T→ TAB Type G→ COG Type F→ COF Type S→ Special
7	LCD Mode：	P→TN Positive N→TN Negative Y→ STN Positive, Yellow Green B→ STN Negative, Blue G→ STN Positive, Gray W→ FSTN Positive T→ FSTN Negative F→ FFSTN Negative S→ Special
8	Viewing direction	6→ 6:00,12→12:00, S→Special
9	Temperature range	N → Normal Temperature W→ Wide Temperature S→ Special
10	LCD Polarizer Type	R→ Reflective T→ Transmissive F→ Transflective S→ Special
11	Backlight Type	N→ None D→ LED E→ EL F→ CCFL S→ Special
12	Backlight Color	Y→ Yellow-green B→ Blue A→ Amber W→ White G→ Green R→ Red S→ Special
13	Internal Code	

2. Precautions in use of LCD Modules

(1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
(2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
(3) Don't disassemble the LCM.
(4) Don't operate it above the absolute maximum rating.
(5) Don't drop, bend or twist LCM.
(6) Soldering: only to the I/O terminals.
(7) Storage: please storage in anti-static electricity container and clean environment.

3. General Specification

Item	Dimension	Unit
Number of Characters	16 characters x 2 Lines	—
Module dimension (With LED Backlight)	80.0 x 36.0 x 14.0 (MAX)	mm
View area	64.5 x 15.5	mm
Active area	56.20 x 11.50	mm
Dot size	0.55x 0.65	mm
Dot pitch	0.60 x 0.70	mm
Character size	2.95 x 5.55	mm
Character pitch	3.55 x 5.95	mm
LCD type	STN, Transflective	
Duty	1/16	
View direction	6 o'clock	
Backlight Type	Yellow-green/White LED backlight	

4. Absolute Maximum Ratings

Item		Symbol	Min	Max	Unit
Input Voltage		V_I	-0.3	VDD+0.3	V
Supply Voltage For Logic		VDD-V_{SS}	-0.3	5.5	V
Supply Voltage For LCD		V_{DD}-V_0	Vdd-7.0	Vdd+0.3	V
Wide Temperature LCM	Operating Temp.	Top	-20	70	°C
	Storage Temp.	Tstr	-30	80	°C

5. Electrical Characteristics

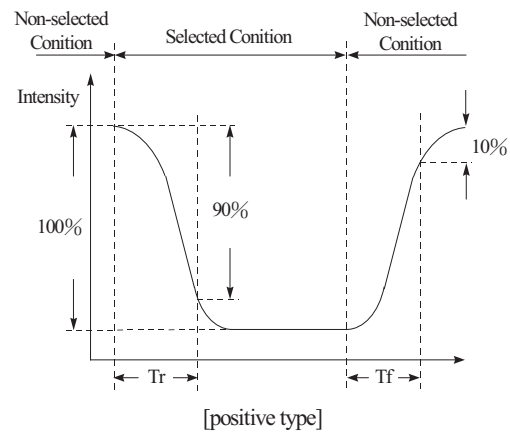| Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	—	4.5	5.0	5.5	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=25°C	4.5	5.0	5.5	V
Input High Volt.	V_{IH}	—	$0.7\,V_{DD}$	—	V_{DD}	V
Input Low Volt.	V_{IL}	—	V_{SS}	—	$0.3\,V_{DD}$	V
Supply Current	I_{DD}	V_{DD}=5V	0.8	1.2	1.5	mA
Supply Voltage of Yellow-green backlight	V_{LED}	Forward current =120 mA Number of LED die 2x12= 24	3.8	4.1	4.3	V
Supply Voltage of White backlight	V_{LED}	Forward current =30 mA Number of LED die 1x2= 2	3.8	4.1	4.3	V

6. 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 Operation Voltage (Vop)   **Definition of Response Time (Tr, Tf)**
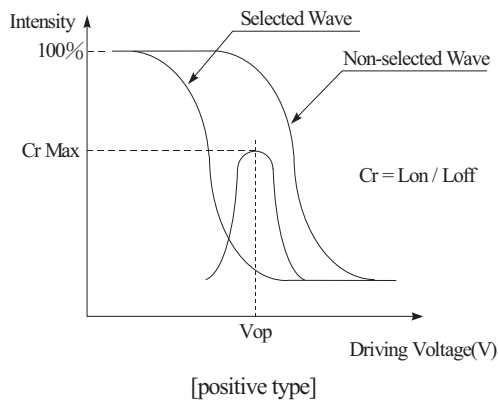
Intensity

100%

Selected Wave

Non-selected Wave

Cr Max

Cr = Lon / Loff

Vop

Driving Voltage(V)

[positive type]

Non-selected Conition   Selected Conition   Non-selected Conition

Intensity

100%

90%

10%

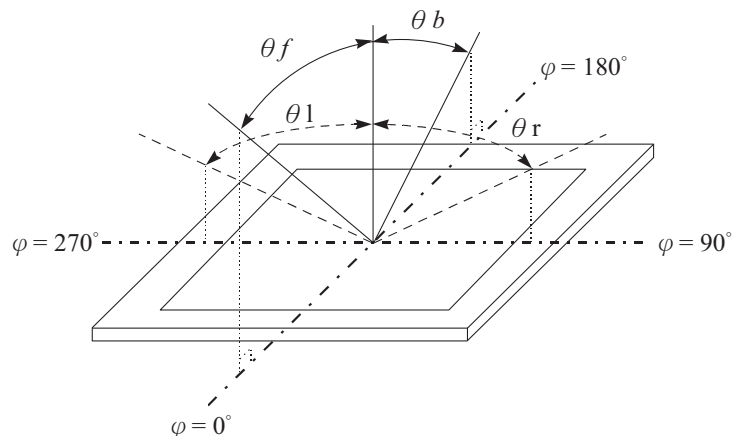Tr   Tf

[positive type]

Conditions:

Operating Voltage: Vop   Viewing Angle (θ，φ): 0°， 0°

Frame Frequency: 64 HZ   Driving Waveform: 1/N duty, 1/a bias

Definition of viewing angle (CR≧2)

θ f   θ b

θ 1   θ r

φ = 180°

φ = 270°   φ = 90°

φ = 0°

7. Interface Pin Function

| Pin No.	Symbol	Level	Description
1	LED(+)		Anode of LED Backlight
2	LED(-)		Cathode of LED Backlight
3	V_{SS}	0V	Ground
4	V_{DD}	5.0V	Supply Voltage for logic
5	SCLK	H/L	Serial Clock
6	SID	H/L	Serial Data
7	V0	(Variable)	Operating voltage for LCD
8	/CSB	H/L	Chip Select
9	RS	H/L	Register Select
10	NC		No Connection

8. Power Supply

SINGLE SUPPLY VOLTAGE TYPE
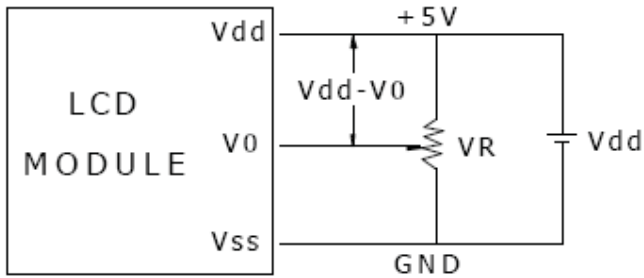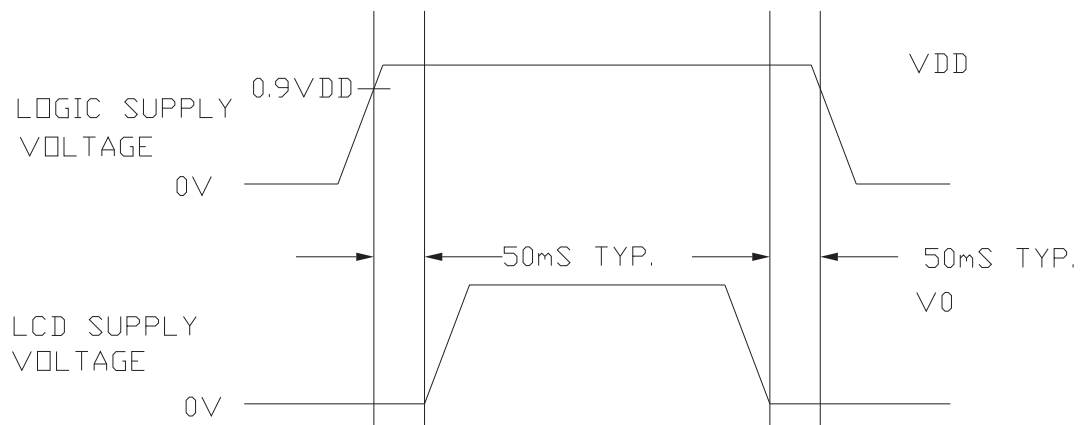

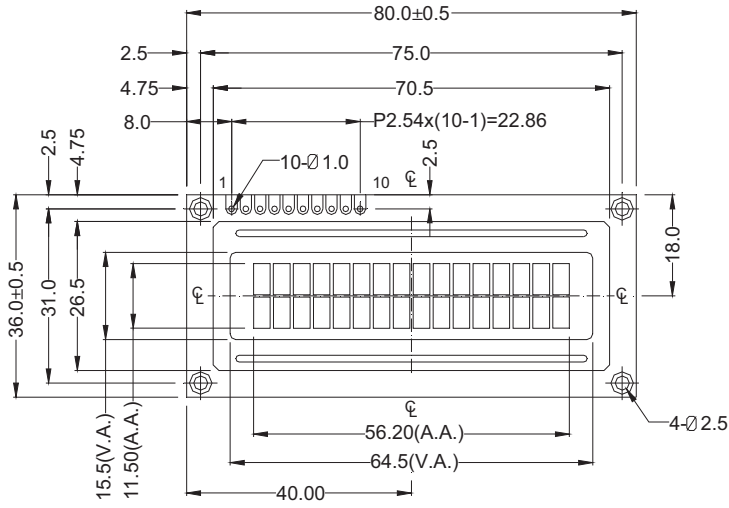Vdd-V0: LCD Driving Voltage
VR: 10K - 20K

DUAL SUPPLY VOLTAGE TYPE
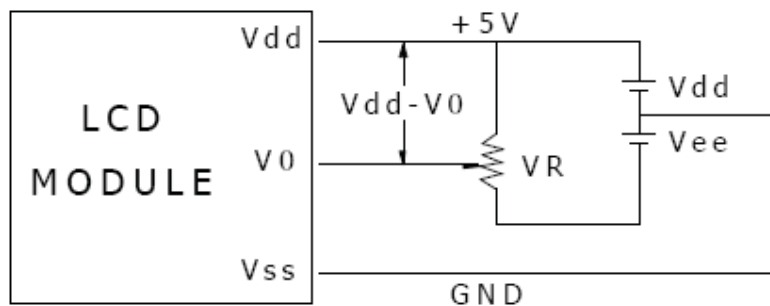
Vdd-V0: LCD Driving Voltage
VR: 10K - 20K

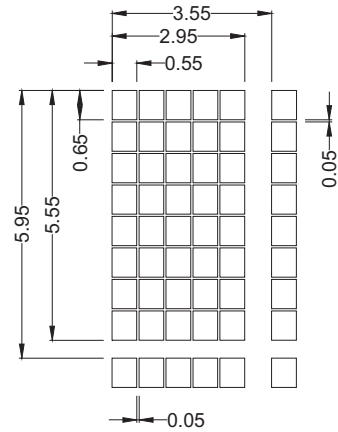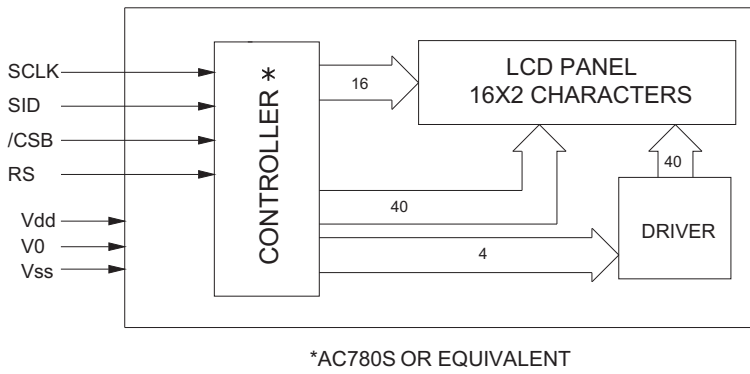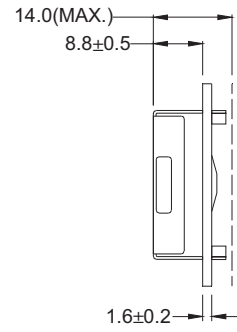**Timing Diagram of VDD Against V0.**

Power on sequence shall meet the requirement of Figure 4, the timing diagram of VDD against V0.

9. Contour Drawing & Block Diagram

BOTTOM LIT LED B/L

CONTROLLER *

LCD PANEL
16X2 CHARACTERS

DRIVER

SCLK
SID
/CSB
RS

Vdd
V0
Vss

16
40
4
40

*AC780S OR EQUIVALENT

10. Function Description

The LCD display Module is built in a 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.

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. Below figure is the relationships between DDRAM addresses and positions on the liquid crystal display.

High bits   Low bits

Example: DDRAM addresses 4E

AC (hexadecimal)

AC6	AC5	AC4	AC3	AC2	AC1	AC0

1	0	0	1	1	1	0
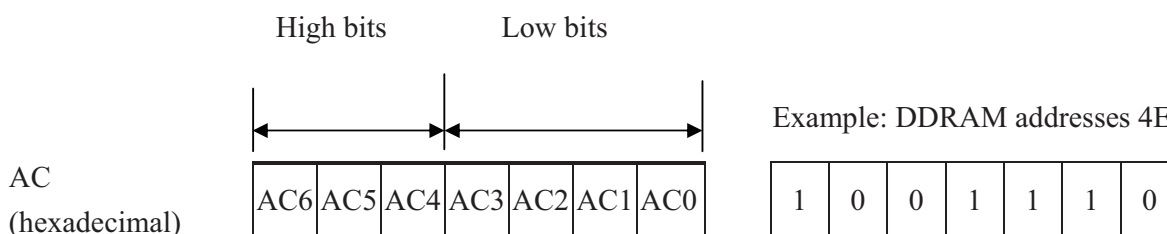
Display position DDRAM address

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 generate 5×8 dot or 5×10 dot character patterns from 8-bit character codes. See Table 2.

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.

Write into DDRAM the character code at the addresses shown as 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

For 5 * 8 dot character patterns

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

For 5 * 10 dot character patterns

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

⬛ : " High "

11. Character Generator ROM Pattern

b7~4 / b3~0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM [00]															
0001	CG RAM [01]															
0010	CG RAM [02]															
0011	CG RAM [03]															
0100	CG RAM [04]															
0101	CG RAM [05]															
0110	CG RAM [06]															
0111	CG RAM [07]															
1000	CG RAM [00]															
1001	CG RAM [01]															
1010	CG RAM [02]															
1011	CG RAM [03]															
1100	CG RAM [04]															
1101	CG RAM [05]															
1110	CG RAM [06]															
1111	CG RAM [07]															

12. Instruction Table

| Instruction	Instruction Code										Description	Execution time (fosc=210Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.98ms
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.	1.98ms
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.	48μs
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	48μs
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.	48μs
Function Set	0	0	0	0	1	DL	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)	48μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	48μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	48μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	48μs

＊ "−"：N/A

13. Interface with MPU

● **For serial interface data, bus lines (DB5 to DB7) are used. 4-Line SPI**

If 4-Pin SPI mode is used, CSB (DB5), SID (DB7), SCLK (DB6), and RS are used. They are chip selection; serial input data, serial clock input, and data/instruction section, relatively. The example of timing sequence is shown below.
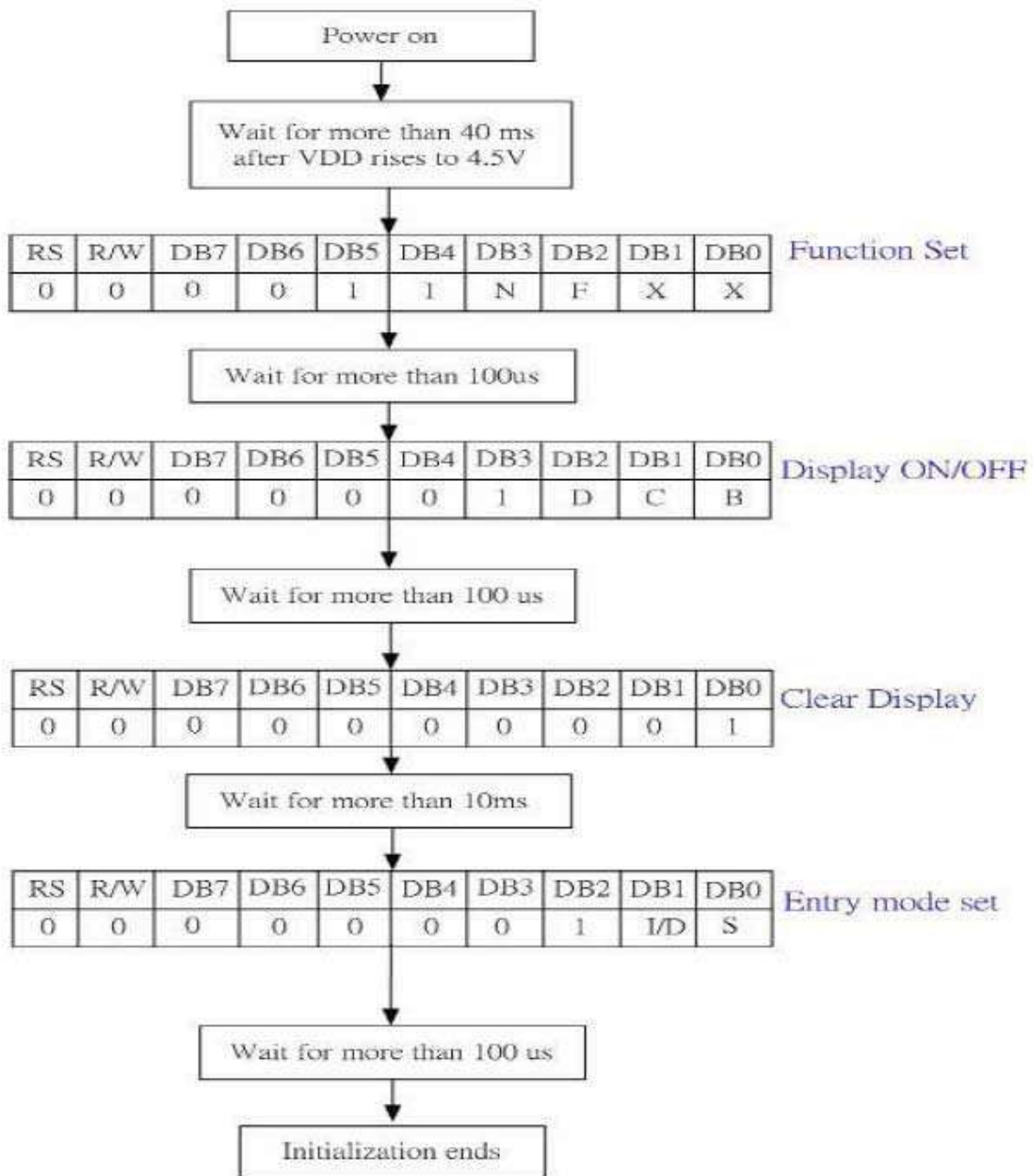
➤ **Example of timing sequence**
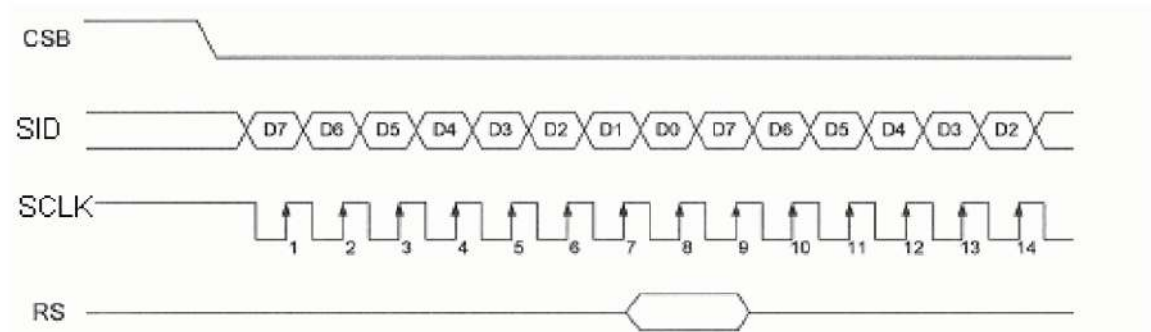
Note: Following is the master SPI clock mode of MPU.
Idle state for clock is a high level, data transmitted on rising edge of SCLK, and data is hold during low level.

14. Initializing of LCM

Initial Code:

void InitRW1063(void)

{

    WriteInst (0x38);   //DL=1: 8 bits; N=1: 2 line; F=0: 5 x 8dots

    WriteInst (0x0c);   // D=1, display on; C=B=0; cursor off; blinking off;

    WriteInst (0x06);   // I/D=1: Increment by 1; S=0: No shift

}
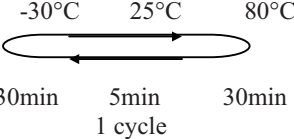
15. Quality Assurance

Screen Cosmetic Criteria

Item	Defect	Judgment Criterion	Partition
1	Spots	A)Clear <u> Size: d mm </u> <u>Acceptable Qty in active area</u> d $\leqq$0.1 Disregard 0.1<d$\leqq$0.2 6 0.2<d$\leqq$0.3 2 0.3<d 0 Note: Including pin holes and defective dots which must be within one pixel size. B)Unclear <u>Size: d mm </u> <u>Acceptable Qty in active area</u> d $\leqq$0.2 Disregard 0.2<d$\leqq$0.5 6 0.5<d$\leqq$0.7 2 0.7<d 0	Minor
2	Bubbles in Polarizer	<u> Size: d mm </u> <u>Acceptable Qty in active area</u> d$\leqq$0.3 Disregard 0.3<d$\leqq$1.0 3 1.0<d$\leqq$1.5 1 1.5<d 0	Minor
3	Scratch	In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
4	Allowable Density	Above defects should be separated more than 30mm each other.	Minor
5	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only.	Minor

16. Reliability

Content of Reliability Test

Environmental Test			
Test Item	**Content of Test**	**Test Condition**	**Applicable Standard**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80 96hrs	____
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30°C 96hrs	____
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 96hrs	____
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 96hrs	____
High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	80°C, 90%RH 96hrs	____
High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	70°C, 90%RH 96hrs	____
Temperature Cycle	Endurance test applying the low and high temperature cycle. -30°C 25°C 80°C 30min 5min 30min 1 cycle	-30°C →80°C 10 cycles	____
Mechanical Test			
Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	____
Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msedc 3 times of each direction	____

***Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25°C