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ISO 9001
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C204A-BW-LW25

Product Description

- 20x4 Character LCD
- STN Blue Negative
- 98.0x60.0mm Module
- 4-bit or 8-bit MPU Interface(s)
- White LED Backlight

- Transmissive
- Wide Temperature Range
- 5.0V
- LCD IC: ST7066U
- RoHS Compliant

LCD@FocusLCDs.com | 480-503-4295

Revision History

Date	Rev. No	Page	Summary
07/07/2023	1.0	All	First issue

Character LCD Features

Characters: 20x4
Interface(s): 4-bit or 8-bit MPU
RoHS Compliant

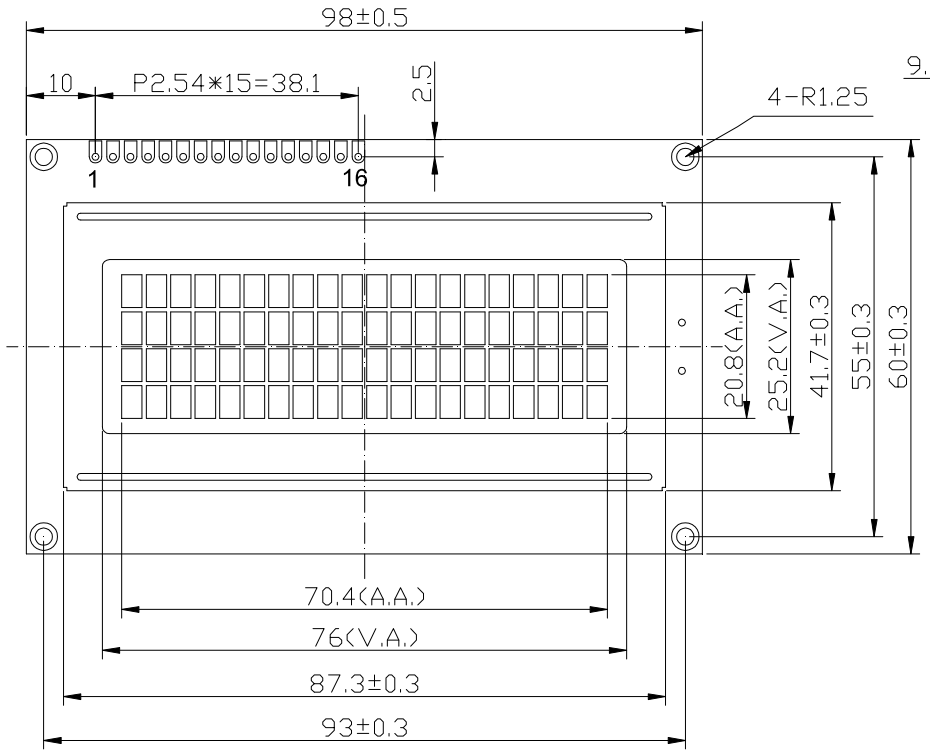
General Information Items	Specification	Unit	Note
	Main Panel		
Viewing Area (VA)	76.0 (H) x 25.2 (V)	mm	--
LCD Type	STN Blue Negative	--	--
Viewing Angle	12:00	O'Clock	--
Polarizer	Transmissive	--	--
Backlight Type	LED	--	--
Backlight Color	White	--	--
LCD IC	ST7066U	--	--
Character Height	4.75	mm	--
Operating Temperature	-20 to +70	°C	--
Storage Temperature	-30 to +80	°C	--

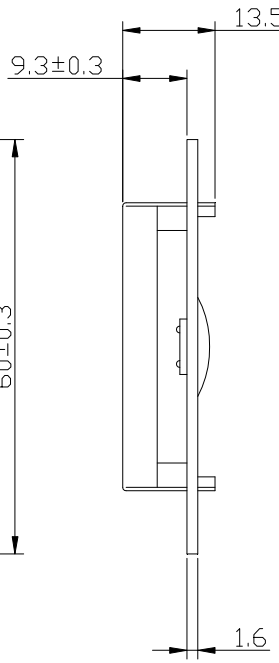
Mechanical Information

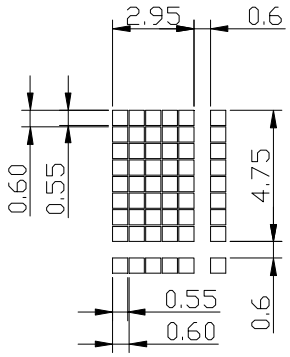
Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	98.0	--	mm	--
	Vertical (V)	--	60.0	--	mm	--
	Depth (D)	--	13.5	--	mm	--
Weight		--	69	--	g	Approximate

1. Outline Dimensions

Rev.	Description	Date
1.0	First	07/07/2023







NO.	PIN
1	VSS
2	VDD
3	V0
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

NOTES:
1. DISPLAY DRIVE: DUTY 1/16, BIAS 1/5, VDD 5.0V, VLCD 4.4V
2. DISPLAY MODE: STN BLUE, TRANSMISSIVE, NEGATIVE
3. LCM DRIVER IC: ST7066U
4. OPERATING TEMPERATURE: -20°C TO +70°C
5. STORAGE TEMPERATURE: -30°C TO +80°C
6. VIEWING DIRECTION: 12:00
7. BACKLIGHT: EDGE WHITE
8. ROHS COMPLIANT.

DISCLAIMER

DO NOT SCALE OFF THIS DRAWING. All dimensions are given in good faith and believed to be correct. These drawings are for general presentation purposes only. No responsibility can be taken with any errors found by measuring off this drawing. The Focus LCDs PDF drawing should be referenced as the master file.

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Model Name: C204A-BW-LW25		FOCUS LCDs LCDs MADE SIMPLE®	
General Tol: ±0.3			
Approvals	Date	Drawing No.:	Scale:
DWN:			
CHK:		Size:	Unit: mm / Page: 1/1
APP:			

2. Input Terminal Pin Assignment

NO.	Symbol	Description	I/O
1	VSS	Signal ground for LCM.	P
2	VDD	Power supply for logic for LCM.	P
3	V0	Contrast adjust.	I
4	RS	Register select signal.	I
5	R/W	Read/write select signal.	I
6	E	Operation (data read/write) enable signal.	I
7-10	DB0-DB3	This is the chip select signal. When /CS1="L" and CS2="H", then the chip select becomes active, and the data/command I/O is enabled.	I/O
11-14	DB4-DB7	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU.	I/O
15	A	Power supply for backlight (anode).	P
16	K	Power supply for backlight (cathode).	P

I: Input, O: Output, P: Power

3. LCD Optical Characteristics

Item		Symbol	Condition	Min	Typ.	Max	Unit
Contrast Ratio		CR	Ta=25°C	2	5	--	
Response Time	On	T_{on}		--	150	250	ms
	Off	T_{off}		--	200	300	ms
Viewing Angle	Hor.	Θ_L	Φ=270°, 9H	50	60	--	degree
		Θ_R	Φ=90°, 3H	50	60	--	
	Ver.	Θ_T	Φ=180°, 12H	30	40	--	
		Θ_B	Φ=0°, 6H	50	60	--	

4. Electrical Characteristics

4.1 Absolute Maximum Rating

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VDD	-0.3	7.0	V
Input Voltage	V_{IN}	-0.3	V_{CC} + 0.3	V
Operating Temperature	T_{OP}	-20	+70	°C
Storage Temperature	T_{ST}	-30	+80	°C

NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.

4.2 DC Electrical Characteristics

Characteristics		Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage for LCD		VLCD	Ta=25°C	4.2	4.4	4.6	V
Input Voltage		VDD		4.8	5.0	5.2	V
Supply Current		IDD	Ta=25°C, VDD=5.0V	1.0	1.5	2.5	mA
Input Leakage Current		I_{LKG}		--	--	3.0	μA
Input Voltage	H Level	V_{IH}		2.2	--	VDD	V
	L Level	V_{IL}		0	--	0.6	V
Output Voltage	H Level	V_{OH}	LOH=-0.25mA	2.4	--	--	V
	L Level	V_{OL}	LOH=1.6mA	--	--	0.4	V

Condition:

1. VDD = 5.0V
2. 1/16 Duty, 1/5 Bias

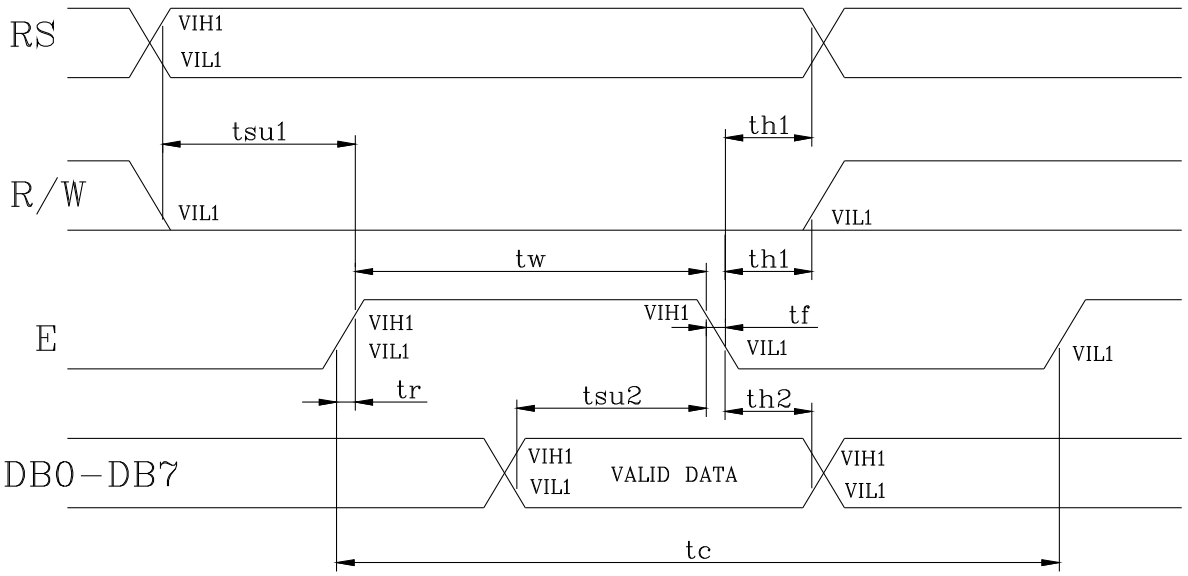
5. Timing Characteristics

Write Cycle (Ta=25˚C, VDD=2.7V)

Parameter	Symbol	Min	Typ.	Max	Unit	Test Pin
Enable Cycle Time	tc	1200	--	--	ns	E
Enable Pulse Width	tw	460	--	--	ns	
Enable Rise/Fall Time	tr, tf	--	--	25	ns	
RS, R/W Setup Time	tsu1	0	--	--	ns	RS, R/W
RS, R/W Address Hold Time	th1	10	--	--	ns	
Read Data Output Delay	tsu2	80	--	--	ns	DB0-DB7
Read Data Hold Time	th2	10	--	--	ns	

Write Cycle (Ta=25˚C, VDD=5.0V)

Parameter	Symbol	Min	Typ.	Max	Unit	Test Pin
Enable Cycle Time	tc	1200	--	--	ns	E
Enable Pulse Width	tw	140	--	--	ns	
Enable Rise/Fall Time	tr, tf	--	--	25	ns	
RS, R/W Setup Time	tsu1	0	--	--	ns	RS, R/W
RS, R/W Address Hold Time	th1	10	--	--	ns	
Read Data Output Delay	tsu2	40	--	--	ns	DB0-DB7
Read Data Hold Time	th2	10	--	--	ns	

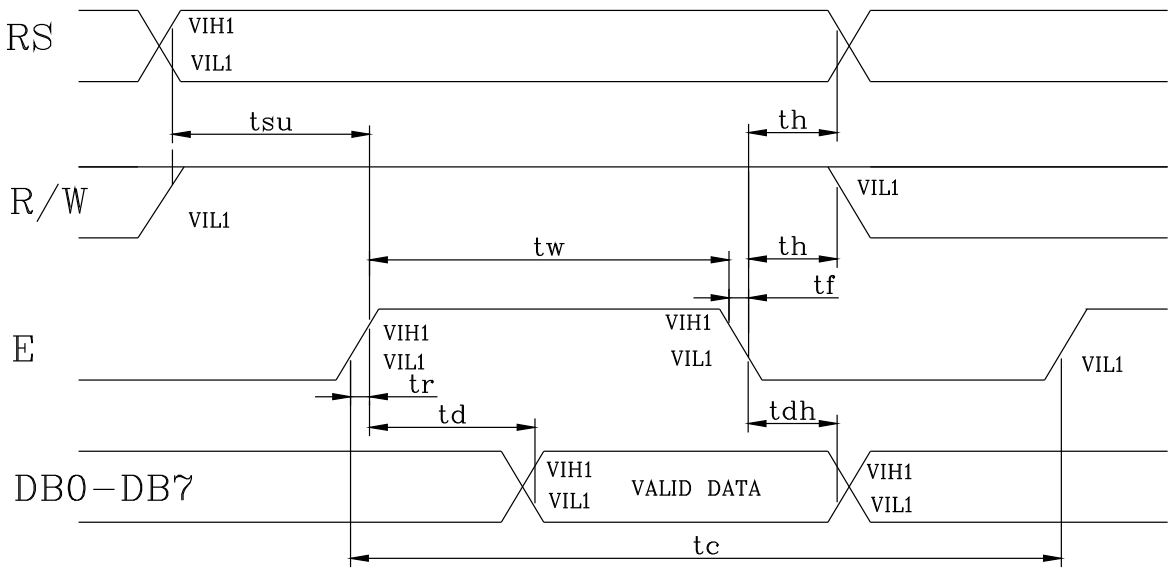


Read Cycle (Ta=25˚C, VDD=2.7V)

Parameter	Symbol	Min	Typ.	Max	Unit	Test Pin
Enable Cycle Time	tc	1200	--	--	ns	E
Enable Pulse Width	tw	480	--	--	ns	
Enable Rise/Fall Time	tr, tf	--	--	25	ns	
RS, R/W Setup Time	tsu	0	--	--	ns	RS, R/W
RS, R/W Address Hold Time	th	10	--	--	ns	
Read Data Output Delay	td	--	--	320	ns	DB0-DB7
Read Data Hold Time	tdh	10	--	--	ns	

Read Cycle (Ta=25˚C, VDD=5.0V)

Parameter	Symbol	Min	Typ.	Max	Unit	Test Pin
Enable Cycle Time	tc	1200	--	--	ns	E
Enable Pulse Width	tw	140	--	--	ns	
Enable Rise/Fall Time	tr, tf	--	--	25	ns	
RS, R/W Setup Time	tsu	0	--	--	ns	RS, R/W
RS, R/W Address Hold Time	th	10	--	--	ns	
Read Data Output Delay	td	--	--	100	ns	DB0-DB7
Read Data Hold Time	tdh	10	--	--	ns	

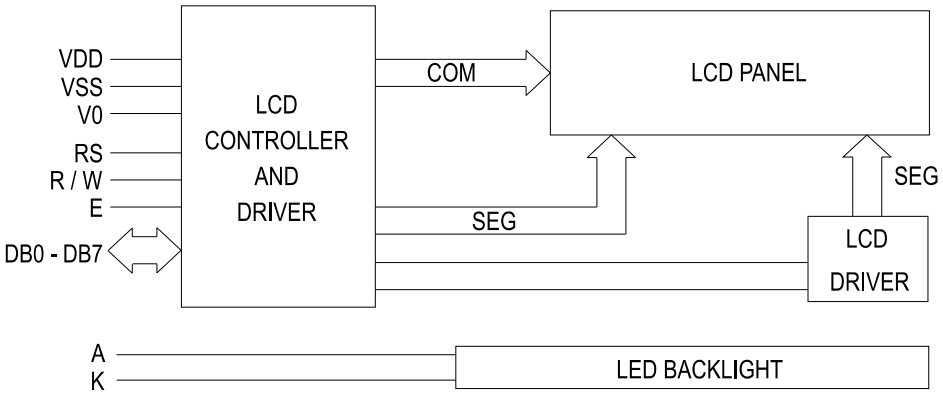


6. Backlight Characteristics

Unless specified, the ambient temperature Ta=25°C.

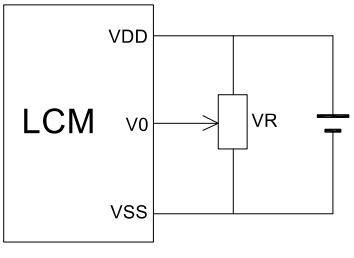
Characteristics	Symbol	Min	Typ.	Max	Unit
Forward Voltage	V_F	4.8	5.0	5.2	V
Forward Current	I_F	20	30	40	mA
Reverse Voltage	V_R	--	5.0	--	V
Peak Wave Length	λp	--	--	--	nm
Luminance	L_V	--	--	--	Cd/m2
Operating Temperature Range	T_{OP}	-20	-	+70	°C
Storage Temperature Range	T_{ST}	-30	-	+80	°C

7. Block Diagram

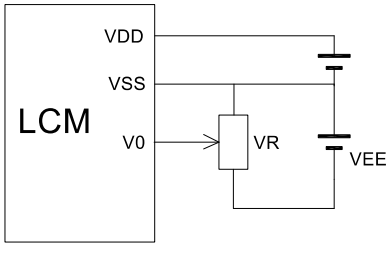


8. Contrast Adjusting Circuit

For single source.



Internal Power



External Power

VDD-V0: LCD Driving Voltage
VR: 10k-20k

9. Instructions

To overcome the speed difference between the internal clock of ST7066 (or equivalent) and the MPU clock, ST7066 performs internal operations by storing control in formations to IR or DR. The internal operation is determined according to the signal from MPU, composed of read/write and data bus. Instructions are divided into four groups:

1) ST7066 function set instructions (set display methods, set data length, etc.)
2) Address set instructions to internal RAM
3) Data transfer instructions with internal RAM
4) Others

The address of the internal RAM is automatically increased or decreased by 1.

Note: during internal operation, busy flag (DB7) is read "High". Busy flag check must be preceded by the next instruction.

9.1 Instruction Table

Instruction	Instruction Code										Description	Exc.Time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		(f_{OSC}=270KHz)
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.52 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 μs
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	37 μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 μs
Function Set	0	0	0	0	1	DL	N	F	x	x	DL:interface data is 8/4 bits N:number of line is 2/1 F:font size is 5x11/5x8	37 μs
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37 μs
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37 μs
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.	0 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	37 μs
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	37 μs

NOTE: When an MPU program with checking the busy flag (DB7) is made, it must be necessary 1/2f_{OSC} is necessary for executing the next instruction by the falling edge of the "E" signal after the busy flag (DB7) goes to "Low".

Be sure the ST7066U is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

9.2 Contents

9.2.1 Clear Display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status, namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

9.2.2 Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	x

Return Home is cursor return home instruction. Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

9.2.3 Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	S

Set the moving direction of cursor and display.

I/D: Increment / decrement of DDRAM address (cursor or blink)
When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.
When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.
* CGRAM operates the same as DDRAM, when read from or write to CGRAM.
S: Shift of entire display
When DDRAM read (CGRAM read/write) operation or S = "Low", shift of entire display is not performed. If S = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" : shift left, I/D = "0" : shift right).

S	I/D	Description
H	H	Shift the display to the left
H	L	Shift the display to the right

9.2.4 Display ON/OFF

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D: Display ON/OFF control bit
When D = "High", entire display is turned on.
When D = "Low", display is turned off, but display data is remained in DDRAM.
C: Cursor ON/OFF control bit
When C = "High", cursor is turned on.
When C = "Low", cursor is disappeared in current display, but I/D register remains its data.
B: Cursor Blink ON/OFF control bit
When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.
When B = "Low", blink is off.

9.2.5 Cursor or Display Shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	x	x

Without writing or reading of display data, shift right/left cursor position or display. This instruction is used to correct or search display data. During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line. Note that display shift is performed simultaneously in all the line. When displayed data is shifted repeatedly, each line shifted individually. When display shift is performed, the contents of address counter are not changed.

S/C	R/L	Description	AC Value
L	L	Shift cursor to the left	AC=AC-1
L	H	Shift cursor to the right	AC=AC+1
H	L	Shift display to the left. Cursor follows the display shift	AC=AC
H	H	Shift display to the right. Cursor follows the display shift	AC=AC

9.2.6 Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	x	x

DL: Interface data length control bit
When DL = "High", it means 8-bit bus mode with MPU.
When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit bus mode.
When 4-bit bus mode, it needs to transfer 4-bit data by two times.
N: Display line number control bit
When N = "Low", it means 1-line display mode.
When N = "High", 2-line display mode is set.
F: Display font type control bit
When F = "Low", it means 5 x 8 dots format display mode.
When F = "High", 5 x11 dots format display mode.

N	F	No. of Display Lines	Character Font	Duty Factor
L	L	1	5x8	1/8
L	H	1	5x11	1/11
H	x	2	5x8	1/16
L	L	1	5x8	1/8

9.2.7 Set CGRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.
This instruction makes CGRAM data available from MPU.

9.2.8 Set DDRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.
This instruction makes DDRAM data available from MPU.
When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH".
In 2-line display mode (N = 1), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9.2.9 Read Busy Flag and Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

When BF = “High”, indicates that the internal operation is being processed, so during this time the next instruction cannot be accepted.
The address Counter (AC) stores DDRAM/CGRAM addresses, transferred from IR.
After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1.

9.2.10 Write Data to CGRAM or DDRAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.
The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction: DDRAM address set, CGRAM address set. RAM set instruction can also determine the AC direction to RAM.
After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

9.2.11 Read Data from CGRAM or DDRAM

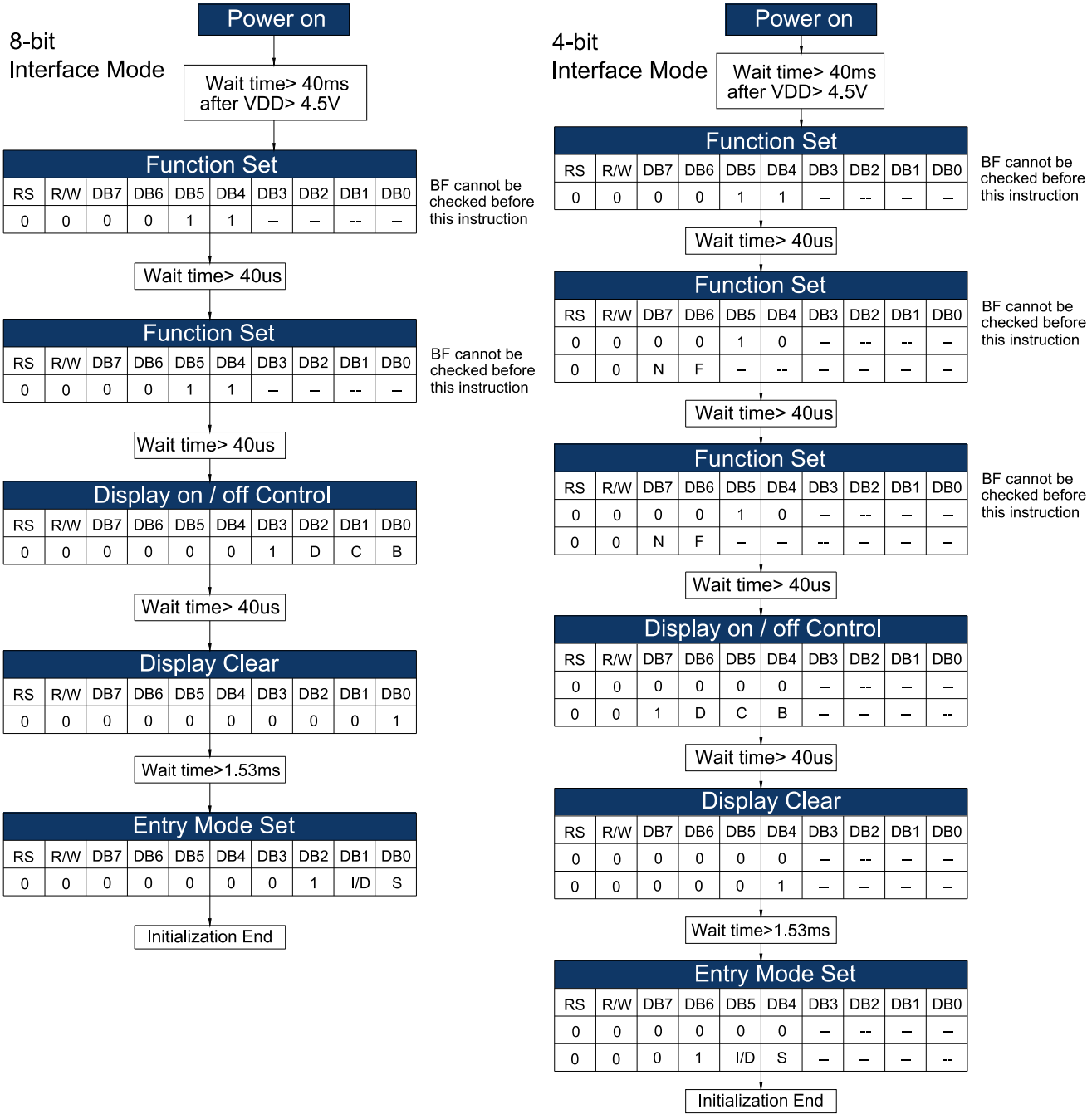
RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.
The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.
In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction: it also transfer RAM data to output data register. After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.
* In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

10. Standard Character Pattern

Note: ROM Code= 0A (ST7066-0A)

11. Initializing By Instruction



12. Cautions and Handling

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotriflorothan. Do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting.
5. When mounting the LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate, and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore, operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C+10°C.
4. Soldering time: 3 to 4 seconds.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage under 40°C is required and the relative humidity should be kept below 60%.