

DM-LCD14432-464
14432 FSTN(+) GRAPHIC LCD WITH
PARALLEL MPU INTERFACE

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1 Revision History

Date	Changes
2015-04-15	First release

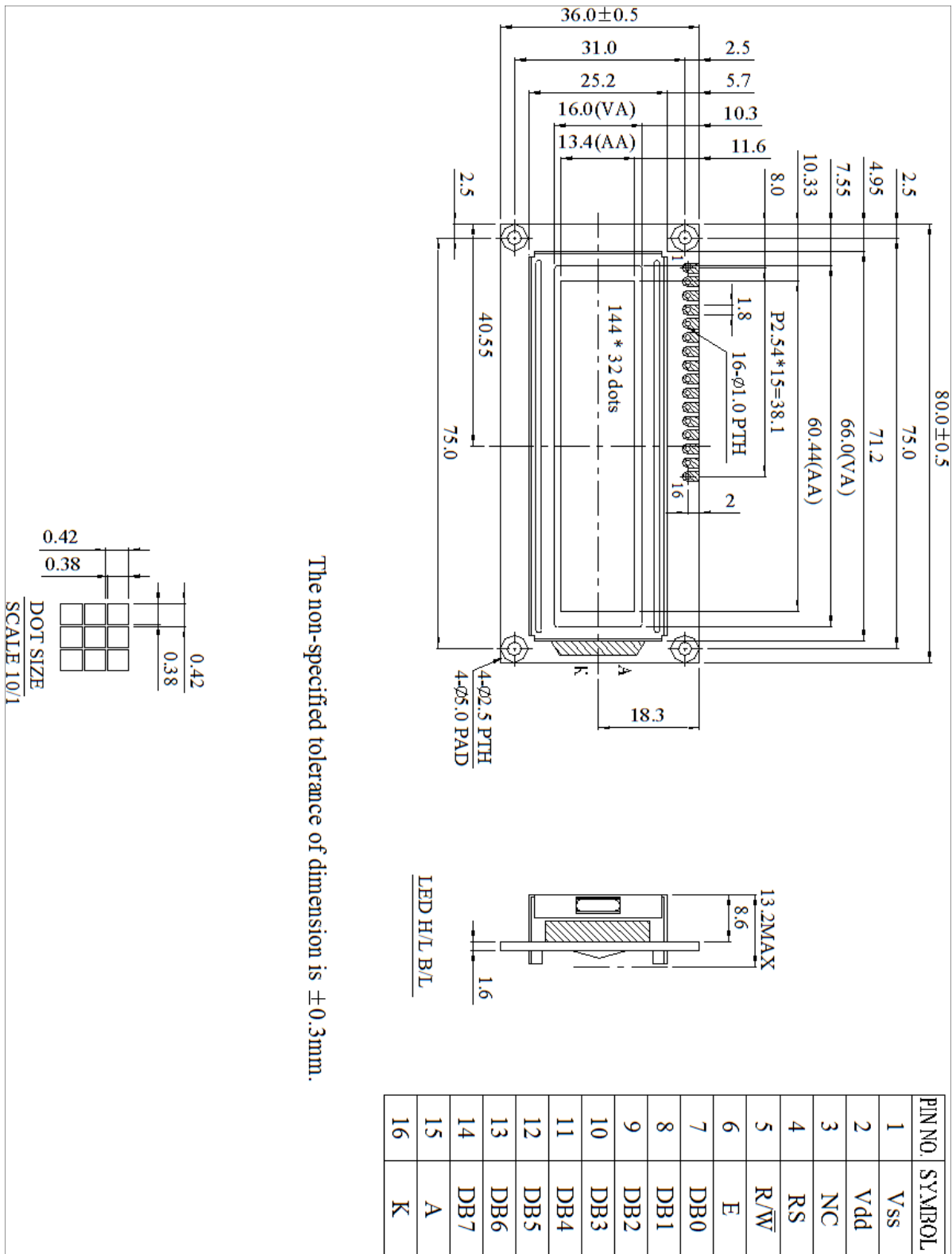
2 Main Features

Item	Specification	Unit
Resolution	144 x 32	dots
Display Mode	FSTN Positive, Transflective	-
Module dimension	80.0 x 36.0 x 13.2(MAX)	mm
Controller IC	ST7920	-
Interface	Parallel MPU Interface	-
Power Supply	5.0	V
View Direction	6:00	-
Duty	1/32	-
Backlight	White LED	-
Weight	31.9	g

3 Pin Description

Pin No.	Symbol	Description
1	Vss	GND
2	Vdd	Power supply
3	NC	No Connection
4	RS	H/L register select signal
5	R/W	H/L Read/Write signal
6	E	Enable signal
7	DB0	Data bus line
8	DB1	Data bus line
9	DB2	Data bus line
10	DB3	Data bus line
11	DB4	Data bus line
12	DB5	Data bus line
13	DB6	Data bus line
14	DB7	Data bus line
15	A	Power supply for B/L +
16	K	Power supply for B/L -

4 Mechanical Drawing



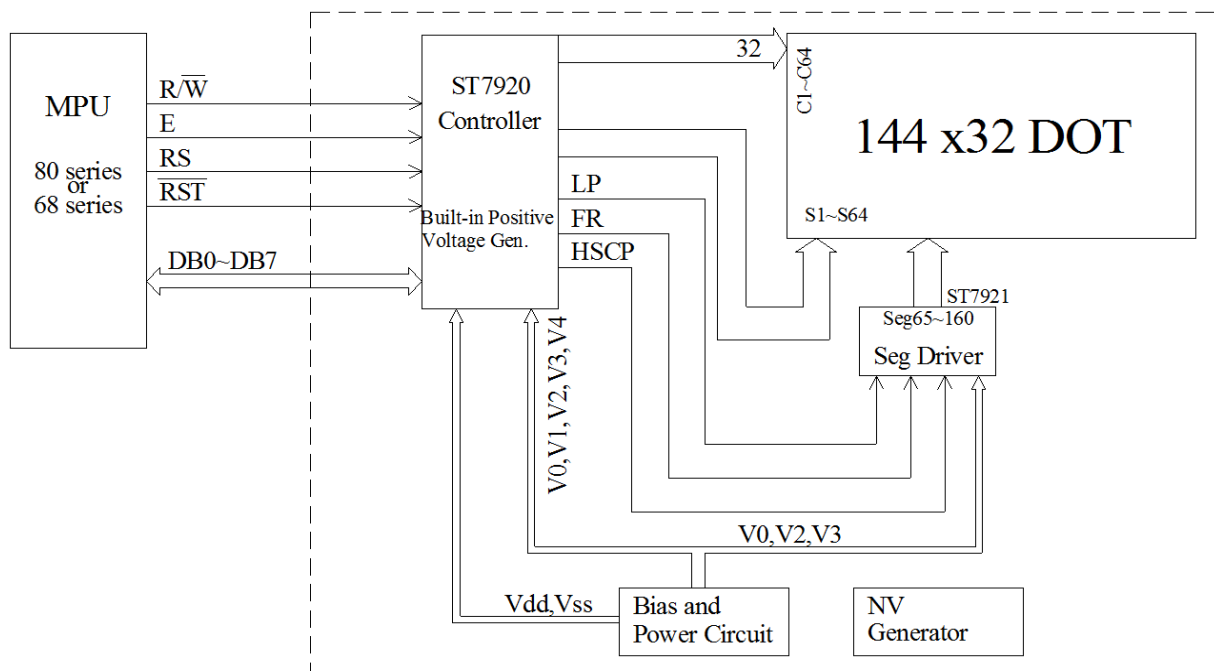
5 Electrical Characteristics

Item	Symbol	Condition	Min	Typ.	Max	Unit
Supply Voltage For Logic	VDD		4.5	5.0	5.5	V
Supply Current	IDD	VDD=5.0V	2.0	2.5	3.5	mA
Low Level Input Voltage	V _{IL}		-0.3	-	0.6	V
High Level Input Voltage	V _{IH}		0.7VDD	-	VDD	V
Low Level Output Voltage	V _{OL}		0		0.4	V
High Level Output Voltage	V _{OH}		0.8VDD		VDD	V
Backlight Supply Voltage	V		3.4	3.5	3.6	V
Backlight Supply Current	I _{LED}			32	40	mA
Operating Temperature	TOP	Absolute Max	-20	-	+70	°C
Storage Temperature	TST	Absolute Max	-30	-	+80	°C

6 Optical Characteristics

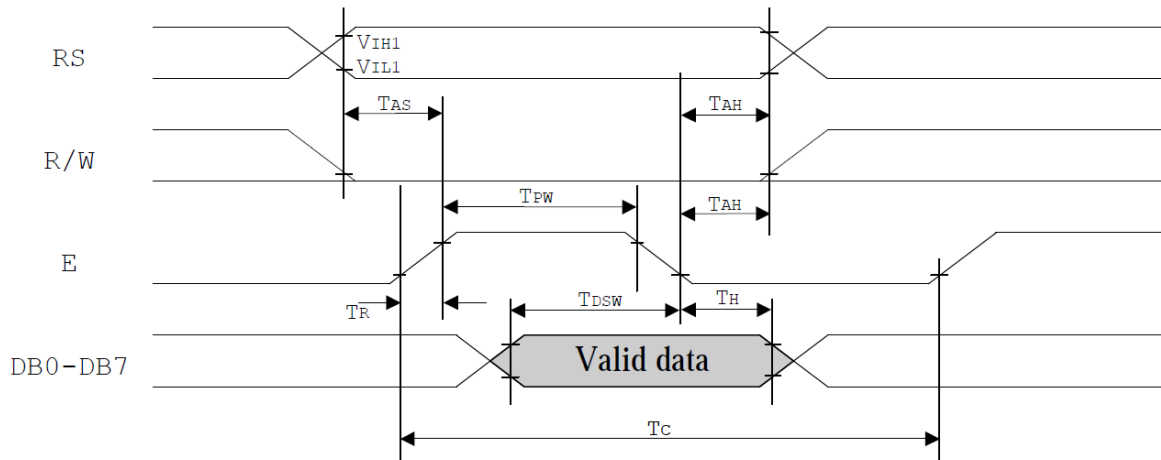
Item	Symbol	Min	Typ	Max	Unit	Note
View Angles Top	AV		30		°	
View Angles Bottom	AV		60		°	
View Angles Left	AH		45		°	
View Angles Right	AH		45		°	
Response Time (25°C)	Tr + Tf		300	400	ms	
Contrast Ratio	CR		5			
Luminance (Without LCD)	Ly	400	500		cd/m ²	

7 Block Diagram



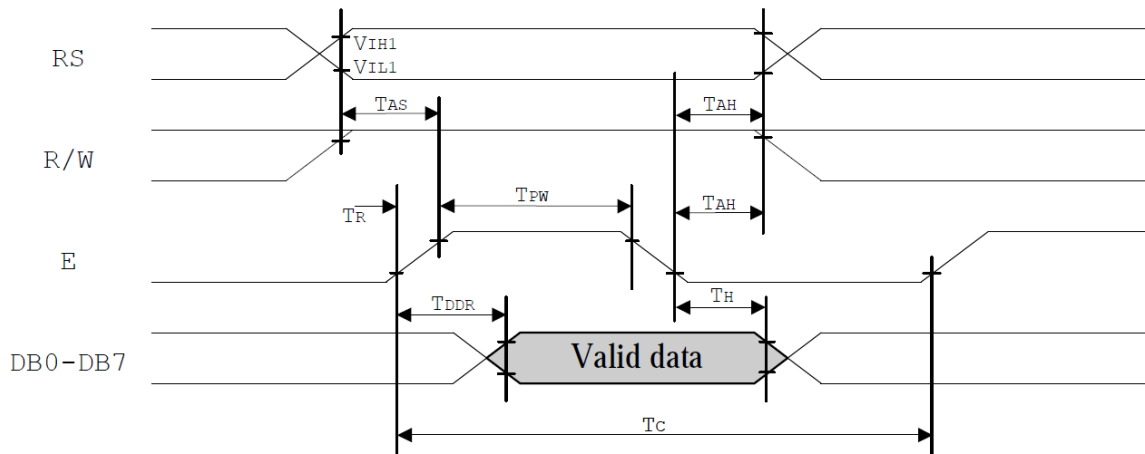
8 Timing Characteristics

8.1 MPU write data to ST7920



Symbol	Parameter	Min	Typ	Max	Unit
T_C	Enable Cycle Time	1800	-	-	ns
T_{PW}	Enable Pulse Width	160	-	-	ns
T_{R,T_F}	Enable Rise/Fall Time	-	-	25	ns
T_{AS}	Address Setup Time	10	-	-	ns
T_{AH}	Address Hold Time	20	-	-	ns
T_{DSW}	Data Setup Time	40	-	-	ns
T_H	Data Hold Time	20	-	-	ns

8.2 MPU read data from ST7920



Symbol	Parameter	Min	Typ	Max	Unit
t_C	Enable Cycle Time	1800	-	-	MHz
t_{PW}	Enable Pulse Width	320	-	-	ns
t_R, t_F	Enable Rise/Fall Time	-	-	25	ns
t_{AS}	Address Setup Time	10	-	-	ns
t_{AH}	Address Hold Time	20	-	-	ns
t_{DDR}	Data Delay Time	-	-	260	ns
t_H	Data Hold Time	20	-	-	ns

9 Instruction Description

Instruction Set 1: (RE=0:Basic Instruction)

Inst.	Code										Description	Exec time (540KHZ)	
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Display Clear	0	0	0	0	0	0	0	0	0	1	Fill DDRAM with "20H" and set DDRAM address counter (AC) to "00H".	1.6 ms	
Return Home	0	0	0	0	0	0	0	0	0	1	X	Set DDRAM address counter (AC) to "00H", and put cursor to origin : the content of DDRAM are not changed	72 us
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Set cursor position and display shift when doing write or read operation	72 us
Display Control	0	0	0	0	0	0	1	D	C	B	D=1: Display ON C=1: Cursor ON B=1: Character Blink ON	72 us	
Cursor Display Control	0	0	0	0	0	1	S/C	R/L	X	X	Cursor position and display shift control; the content of DDRAM are not changed	72 us	
Function Set	0	0	0	0	1	DL	X	0	X	X	DL=1 :8-bit interface DL=0 :4-bit interface RE=1: extended instruction RE=0: basic instruction	72 us	
Set CGRAM Address.	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address to address counter (AC) Make sure that in extended instruction SR=0 (scroll or RAM address select)	72 us	
Set DDRAM Address.	0	0	1	0	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter (AC) AC6 is fixed to 0	72 us	
Read Busy Flag (BF) & AC.	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read busy flag (BF) for completion of internal operation, also Read out the value of address counter (AC)	0 us	
Write RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to internal RAM (DDRAM/CGRAM/GDRAM)	72 us	
Read RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/GDRAM)	72 us	

Instruction Set 2 :(RE=1:extended instruction)

Inst.	Code										Description	Exec time (540KHZ)	
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Standby	0	0	0	0	0	0	0	0	0	1	Enter standby mode, any other instruction can terminate. COM1...32 are halted.	72 us	
Scroll or RAM Address. Select	0	0	0	0	0	0	0	0	0	1	SR	SR=1: enable vertical scroll position SR=0: enable CGRAM address (basic instruction)	72 us
Reverse (by line)	0	0	0	0	0	0	0	0	1	R1	R0	Select 1 out of 4 line (in DDRAM) and decide whether to reverse the display by toggling this instruction R1,R0 initial value is 0,0	72 us
Extended Function Set	0	0	0	0	1	DL	X	1	RE	G	0	DL=1 :8-bit interface DL=0 :4-bit interface RE=1: extended instruction set RE=0: basic instruction set G=1 :graphic display ON G=0 :graphic display OFF	72 us
Set Scroll Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll	72 us	
Set Graphic Display RAM Address	0	0	1	0	0	0	AC3	AC2	AC1	AC0	Set GDRAM address to address counter (AC) Set the vertical address first and followed the horizontal address by consecutive writings Vertical address range: AC5...AC0 Horizontal address range: AC3...AC0	72 us	

Initial Setting (Register flag) (RE=0:basic instruction)

Inst.	Code										Description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Cursor move to right ,DDRAM address counter (AC) plus 1
									1	0	
Display Control	0	0	0	0	0	0	1	D	C	B	Display, cursor and blink are ALL OFF
								0	0	0	
CURSOR DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	X	X	No cursor or display shift operation
							X	X			
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	8-bit MPU interface , basic instruction set
					1			0			

Initial Setting (Register flag) (RE=1:extended instruction set)

Inst.	Code										Description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
SCROLL OR RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	Allow vertical scroll or set CGRAM address
										0	
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Begin with normal and toggle to reverse
									0	0	
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	Graphic display OFF
									0		

10 Initializing by Instruction

10.1 Description of basic instruction set

Display Clear

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

This instruction will change the following items:

1. Fill DDRAM with "20H"(space code).
2. Set DDRAM address counter (AC) to"00H".
3. Set Entry Mode I/D bit to be "1". Cursor moves right and AC adds 1 after write or read operation

Return Home

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	X

Set address counter (AC) to "00H". Cursor moves to origin. Then content of DDRAM is not changed.

Entry Mode Set

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I/D	S

Set the cursor movement and display shift direction when doing write or read operation.

I/D: Address Counter Control: (Increase/Decrease)

When I/D = "1", cursor moves right, address counter (AC) is increased by 1.

When I/D = "0", cursor moves left, address counter (AC) is decreased by 1.

S: Display Shift Control: (Shift Left/Right)

S	I/D	DESCRIPTION
H	H	Entire display shift left by 1
H	L	Entire display shift right by 1

Display Control

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

Controls display, cursor and blink ON/OFF.

D: Display ON/OFF control bit

When D = "1", display ON

When D = "0", display OFF, the content of DDRAM is not changed

C: Cursor ON/OFF control bit

When C = "1", cursor ON.

When C = "0", cursor OFF.

B: Character Blink ON/OFF control bit

When B = "1", cursor position blink ON. Then display data (character) in cursor position will blink.

When B = "0", cursor position blink OFF

Cursor/Display Shift Control

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code	0	0	0	0	0	1	S/C	R/L	X	X
------	---	---	---	---	---	---	-----	-----	---	---

This instruction configures the cursor moving direction or the display shifting direction. The content of DDRAM is not changed.

S/C	R/L	Description	AC Value
L	L	Cursor moves left by 1 position	AC=AC-1
L	H	Cursor moves right by 1 position	AC=AC+1
H	L	Display shift left by 1, cursor also follows to shift	AC=AC
H	H	Display shift right by 1, cursor also follows to shift	AC=AC

Function Set

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code	0	0	0	0	1	DL	X	RE	X	X
------	---	---	---	---	---	----	---	----	---	---

DL: 4/8-bit interface control bit

When DL = "1", 8-bit MPU bus interface

When DL = "0", 4-bit MPU bus interface

RE: extended instruction set control bit

When RE = "1", extended instruction set

When RE = "0", basic instruction set

In same instruction cannot alter DL and RE at once. Make sure that change DL first then RE.

Set CGRAM Address

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0
------	---	---	---	---	-----	-----	-----	-----	-----	-----

Set CGRAM address into address counter (AC)

AC range is 00H...3FH

Make sure that in extended instruction SR=0 (scroll address or RAM address select)

Set DDRAM Address

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0
------	---	---	---	-----	-----	-----	-----	-----	-----	-----

Set DDRAM address into address counter (AC).

First line AC range is 80H...8FH

Second line AC range is 90H...9FH

Third line AC range is A0H...AFH

Fourth line AC range is B0H...BFH

Please note that only 2 lines can be display with one ST7920.

Read Busy Flag (BF) and Address

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0
------	---	---	----	-----	-----	-----	-----	-----	-----	-----

Read busy flag (BF) can check whether the internal operation is finished or not. At the same time, the value of address counter (AC) is also read. When BF = "1", further instruction(s) will not be accepted until BF = "0".

Write Data to RAM

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write data to the internal RAM and increase/decrease the (AC) by 1
 Each RAM address (CGRAM, DDRAM and GDRAM...) must write 2 consecutive bytes for 16-bit data.
 After receiving the second byte, the address counter will increase or decrease by 1 according to the entry mode set control bit.

Read RAM Data

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read data from the internal RAM and increase/decrease the (AC) by 1
 After the operation mode changed to Read (CGRAM, DDRAM and GDRAM...), a "Dummy Read" is required.
 There is no need to add a "Dummy Read" for the following bytes unless a new address set instruction is issued.

10.2 Description of extended instruction set

Standby

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

This Instruction will set ST7920 entering the standby mode. Any other instruction follows this instruction will terminate the standby mode.
 The content of DDRAM remains the same.

Vertical Scroll or RAM Address Select

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	SR

When SR = "1", the Vertical Scroll mode is enabled.
 When SR = "0", "Set CGRAM Address" instruction (basic instruction) is enabled

Reverse

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	R1	R0

Select 1 out of 4 lines to reverse the display and to toggle the reverse condition by repeating this instruction. R1, R0 initial vale is 00. The first time issuing this instruction, the display will be reversed while the second time will return the display become normal.

R1	R0	Description
L	L	First line normal or reverse
L	H	Second line normal or reverse
H	L	Third line normal or reverse
H	H	Fourth line normal or reverse

Please note that only 2 lines out of 4 lines of display data can be displayed with one ST7920

Extend Function Set

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code

0	0	0	0	1	DL	X	RE	G	X
---	---	---	---	---	----	---	----	---	---

DL: 4/8-bit interface control bit

When DL = "1", 8-bit MPU interface.

When DL = "0", 4-bit MPU interface.

RE: extended instruction set control bit

When RE = "1", extended instruction set

When RE = "0", basic instruction set

G: Graphic display control bit

When G = "1", Graphic Display ON

When G = "0", Graphic Display OFF

In same instruction cannot alter DL, RE and G at once. Make sure that change DL or G first and then RE.

Set Scroll Address

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code

0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0
---	---	---	---	-----	-----	-----	-----	-----	-----

SR=1: AC5~AC0 is vertical scroll displacement address

Set Graphic RAM Address

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code

0	0	1	0	AC5	AC4	AC3	AC2	AC1	AC0
---	---	---	---	-----	-----	-----	-----	-----	-----

RS RW DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

Code

0	0	1	0	0	0	AC3	AC2	AC1	AC0
---	---	---	---	---	---	-----	-----	-----	-----

Set GDRAM address into address counter (AC). This is a 2-byte instruction.

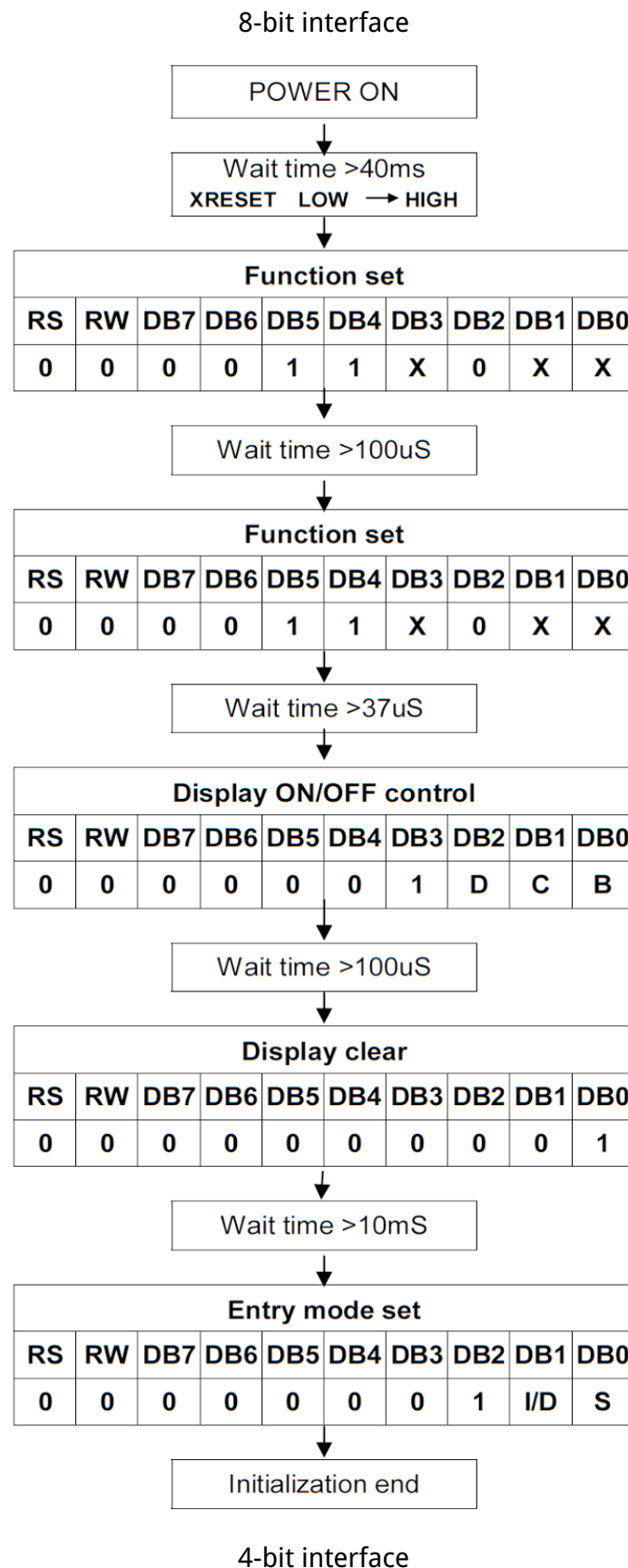
The first instruction sets the vertical address while the second one sets the horizontal address (write 2 consecutive bytes to complete the vertical and horizontal address setting).

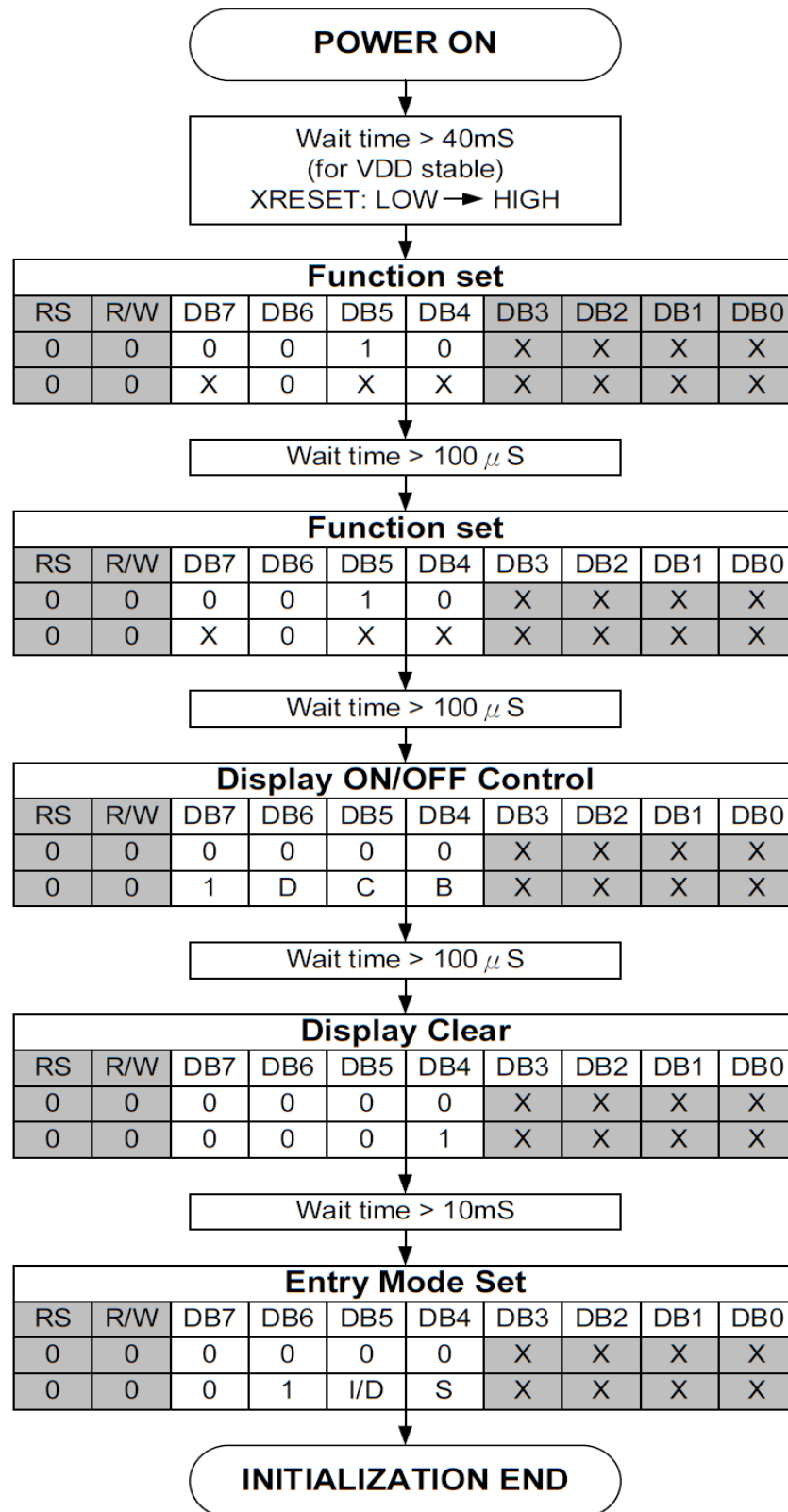
Vertical address range is AC5...AC0

Horizontal address range is AC3...AC0

The address counter (AC) of graphic RAM (GRAM) will be increased automatically after the vertical and horizontal addresses are set. After horizontal address is increased up to 0FH, it will automatically return to 00H. However, the vertical address will not increase as the result of the same action.

11 Example Initialization Code



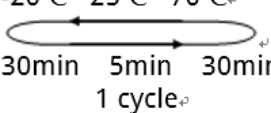


12 Driver/Controller Information

Built-in ST7920 IC

<https://drive.google.com/file/d/0B5IkVYnewKTGX0lzWU42aEd2LVU/view?usp=sharing>

13 Reliability

Test Item	Content of Test	Test Condition	Note
High Temperature Storage	Endurance test applying the high storage temperature for a long time.	80°C 200hrs	2
Low Temperature Storage	Endurance test applying the high storage temperature for a long time.	-30°C 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 200hrs	-
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60°C,90%RH max, for 96hrs under no-load condition excluding the polarizer. Then taking it out and drying it at normal temperature.	60°C,90%RH 96hrs	1,2
Thermal Shock Resistance	The sample should be allowed stand the following 10 cycles of operation. 	-20°C/70°C 10 cycles	-
Vibration Test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude: 15mm; Vibration: 10~55Hz; One cycle 60 seconds to 3 directions of X, Y, Z, for each 16 minutes.	3
Static Electricity Test	Endurance test apply the electric stress to the terminal.	VS=800V, RS=1.5kΩ, CS=100pF, 1 time.	-

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal. Temperature and humidity after remove from the rest chamber.

Note3: Test performed on product itself, not inside a container

14 Warranty and Conditions

<http://www.displaymodule.com/pages/faq>