



XUNGE TECHNOLOGY CO., Ltd.

XGCS12864E-1DDYFYSDf-5.0

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1. General Specifications

1.1. Display Specifications

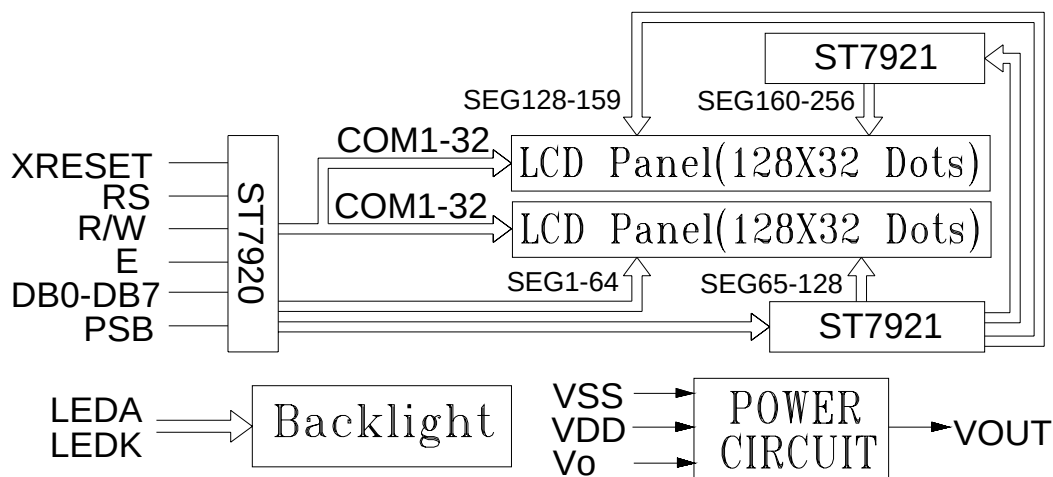
LCD Display Mode	STN, Positive, Transflective, Gray
LCD Display Color	Display Data="1" : BLACK (*1) Display Data="0" : YELLOW-GREEN (*2)
Viewing Angle	6:00
Driving Method	1/33 Duty , 1/5 Bias
Controller IC	ST7920
Interface	6800-series 8bit/4bit interface or Serial Interface
Back Light	Yellow-Green LED Backlight

Note:

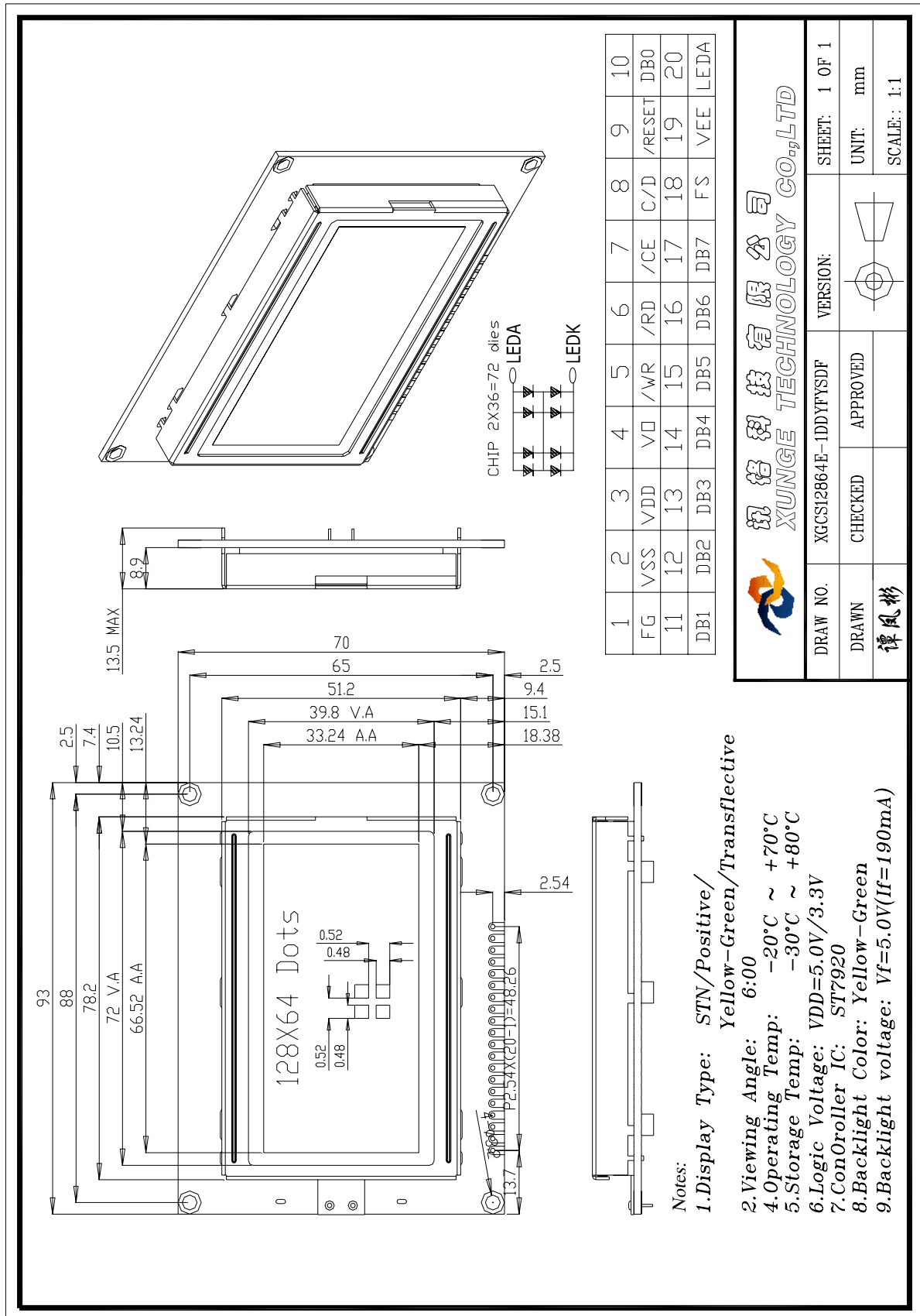
*1. Color tone may slightly change by Temperature and Driving Condition

*2. The Color is defined as the inactive / background color

1.2. Block Diagram



1.3. Mechanical Specifications



1.4. Terminal functions

Pin	Symbol	I/O	Function
1	VSS	Power	Ground for logic
2	VDD	Power	Power supply for logic
3	VO	Power	Power supply for LCD drive
4	RS	INPUT	Register Select RS=H: data read or write RS=L: Instruction data write or status usy flag read
5	R/W	INPUT	Read write control R/W=H: data or status read R/W=L: data or command write (Serial data input)
6	E	INPUT	Enable signal (Serial clock)
7	DB0	I/O	Three state I/O terminal for display data or instruction data in 4 bit Mode. DB3~DB0 could leave open or pull-up.
:	:	:	
14	DB7	I/O	
15	PSB	INPUT	Interface Select: RS=H: 8/4-bits parallel bus mode RS=L: Serial mode
16	NC	-	No connect
17	XRESET	INPUT	System reset low active
18	VOUT	Power	Power booster output for VO reference
19	LEDA	Power	Power supply for backlight +
2-	LEDK	Power	Power supply for backlight -

2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	4	V	$V_{SS}=0V$
Input Voltage	V_{IN}	-0.3	$V_{DD}+0.3$	V	$V_{SS}=0V$
LCD Driving Voltage	V_{EE}	-0.3	7.0	V	$V_{SS}=0V$
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Cautions:

Any stresses exceeding the absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

3. Electrical Characteristics

3.1. DC Characteristics

$V_{SS}=0V$, $V_{DD}=3.3V$, $T_{OP}=25\text{ }^{\circ}C$

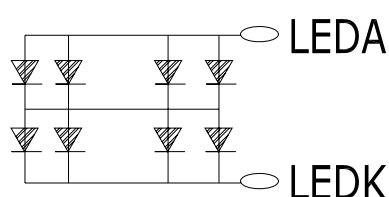
Items	Symbol	Min.	Typ.	Max.	Unit	Condition Pin
Operating Voltage	V_{DD}	4.9	5.0	5.1	V	VDD
LCD Operating Voltage	V_{OP}	-	5.5	-	V	VO
Input High Voltage	V_{IH1}	$0.8 V_{DD}$	-	V_{DD}	V	RS,R/W,E,DB0~DB7
Input Low Voltage	V_{IL1}	V_{SS}	-	0.4	V	
Output High Voltage	V_{OH1}	$0.7 V_{DD}$	-	V_{DD}	V	DB0~DB7($V_{OH}=-0.1mA$)
Output Low Voltage	V_{OL1}	V_{SS}	-	0.2	V	DB0~DB7($V_{OH}=0.1mA$)
Operating Current	I_{DD}	2.0	-	2.5	mA	VDD,VSS

3.2. LED Backlight Circuit Characteristics

$V_{SS}=0V$, $T_{OP}=25\text{ }^{\circ}C$

Items	Symbol	Min.	Typ.	Max.	Unit	Condition Pin
Forward Voltage	$V_{F_{LEDA}}$	-	5.0	5.1-	V	LEDA
Forward Current	$I_{F_{LEDA}}$	-	290	-	mA	LEDA

CHIP 2X36=72 dies



3.3. AC Characteristics

3.3.1. Parallel Mode Interface

 $V_{SS}=0V, V_{DD}=4.5V, T_{OP}=25\text{ }^{\circ}C$

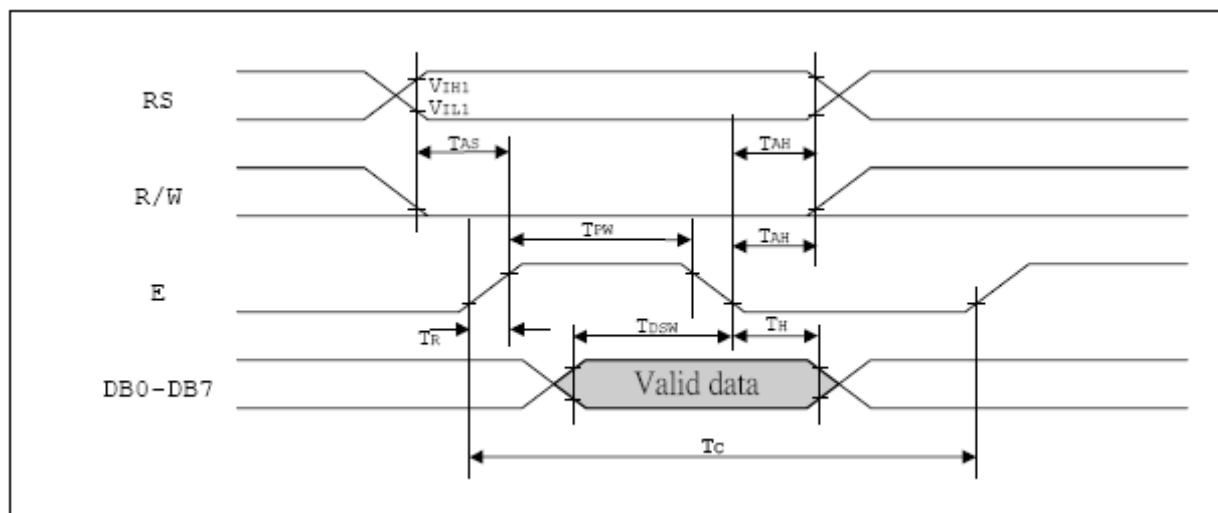
Items	Symbol	Test Condition	Min.	Typ.	Max.	Unit
OSC Frequency	fosc	R=33K	480	540	600	KHz
Write Mode (Write data from MPU to ST7920)						
Enable cycle time	Tc	Pin E	1800	-	-	ns
Enable high Pulse width	Tpw	Pin E	160	-	-	ns
Enable rise/fall time	Tr, Tf	Pin E	-	-	25	ns
Address setup time	Tas	Pins : RS,R/W,E	10	-	-	ns
Address hold time	Tah	Pins : RS,R/W,E	20	-	-	ns
Data setup time	Tdsw	Pins : DB0~DB7	40	-	-	ns
Data hold time	Th	Pins : DB0~DB7	20	-	-	ns
Read Mode (Reading Data from ST7920 to MPU)						
Enable cycle time	Tc	Pin E	1200	-	-	ns
Enable high Pulse width	Tpw	Pin E	140	-	-	ns
Enable rise/fall time	Tr, Tf	Pin E	-	-	25	ns
Address setup time	Tas	Pins : RS,R/W,E	10	-	-	ns
Address hold time	Tah	Pins : RS,R/W,E	20	-	-	ns
Data Delay time	Tddr	Pins : DB0~DB7	-	-	100	ns
Data hold time	Th	Pins : DB0~DB7	20	-	-	ns

 $V_{SS}=0V, V_{DD}=2.7V, T_{OP}=25\text{ }^{\circ}C$

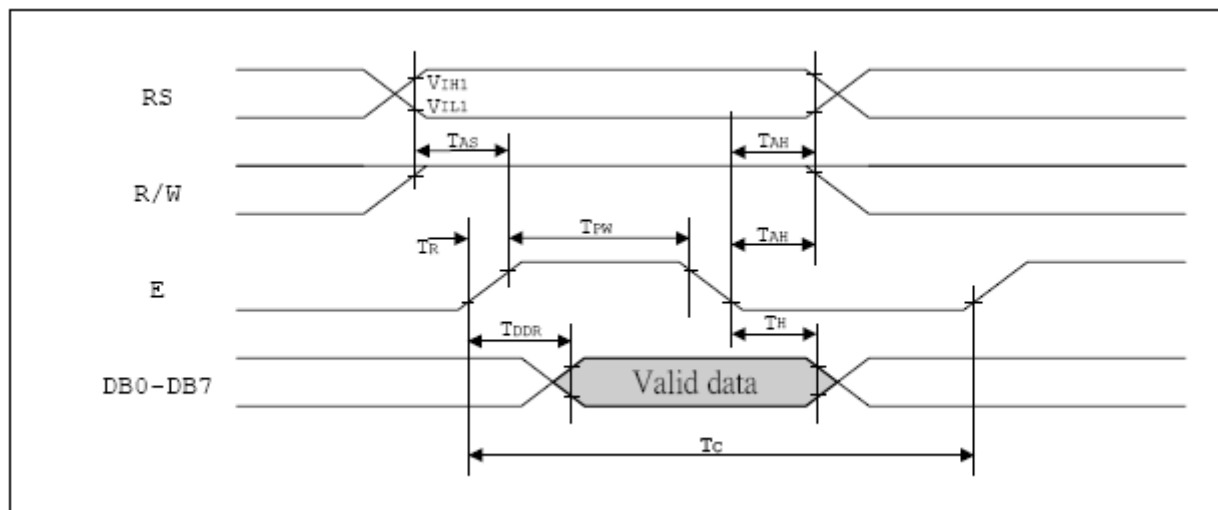
Items	Symbol	Test Condition	Min.	Typ.	Max.	Unit
OSC Frequency	fosc	R=18K	470	530	590	KHz
Write Mode (Write data from MPU to ST7920)						
Enable cycle time	Tc	Pin E	1800	-	-	ns
Enable high Pulse width	Tpw	Pin E	160	-	-	ns
Enable rise/fall time	Tr, Tf	Pin E	-	-	25	ns
Address setup time	Tas	Pins : RS,R/W,E	10	-	-	ns
Address hold time	Tah	Pins : RS,R/W,E	20	-	-	ns
Data setup time	Tdsw	Pins : DB0~DB7	40	-	-	ns
Data hold time	Th	Pins : DB0~DB7	20	-	-	ns
Read Mode (Reading Data from ST7920 to MPU)						
Enable cycle time	Tc	Pin E	1800	-	-	ns
Enable high Pulse width	Tpw	Pin E	320	-	-	ns
Enable rise/fall time	Tr, Tf	Pin E	-	-	25	ns
Address setup time	Tas	Pins : RS,R/W,E	10	-	-	ns
Address hold time	Tah	Pins : RS,R/W,E	20	-	-	ns

Data Delay time	T _{ddr}	Pins : DB0~DB7	-	-	260	ns
Data hold time	T _h	Pins : DB0~DB7	20	-	-	ns

MPU Write Data to ST7920



MPU Read Data from ST7920



3.3.2. Serial Mode Interface

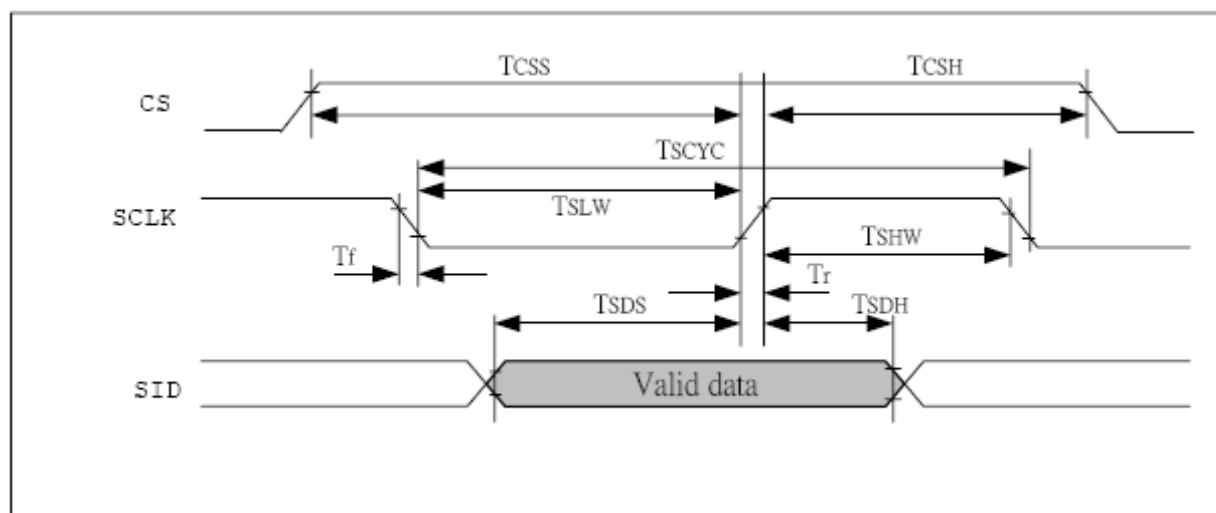
 $V_{SS}=0V, V_{DD}=4.5V, T_{OP}=25\text{ }^{\circ}C$

Items	Symbol	Test Condition	Min.	Typ.	Max.	Unit
OSC Frequency	fosc	R=33K	470	530	590	KHz
Serial clock cycle	TSCYC	Pin E	400	-	-	ns
SCLK high pulse width	TSHW	Pin E	200	-	-	ns
SCLK low pulse width	TSLW	Pin E	200	-	-	ns
SID data setup time	TSDS	Pins : R/W	40	-	-	ns
SID data hold time	TSDH	Pins : R/W	40	-	-	ns
CS setup time	TCSS	Pins : RS	60	-	-	ns
CS hold time	TCSH	Pins : RS	60	-	-	ns

 $V_{SS}=0V, V_{DD}=2.7V, T_{OP}=25\text{ }^{\circ}C$

Items	Symbol	Test Condition	Min.	Typ.	Max.	Unit
OSC Frequency	fosc	R=33K	470	530	590	KHz
Serial clock cycle	TSCYC	Pin E	600	-	-	ns
SCLK high pulse width	TSHW	Pin E	300	-	-	ns
SCLK low pulse width	TSLW	Pin E	300	-	-	ns
SID data setup time	TSDS	Pins : R/W	40	-	-	ns
SID data hold time	TSDH	Pins : R/W	40	-	-	ns
CS setup time	TCSS	Pins : RS	60	-	-	ns
CS hold time	TCSH	Pins : RS	60	-	-	ns

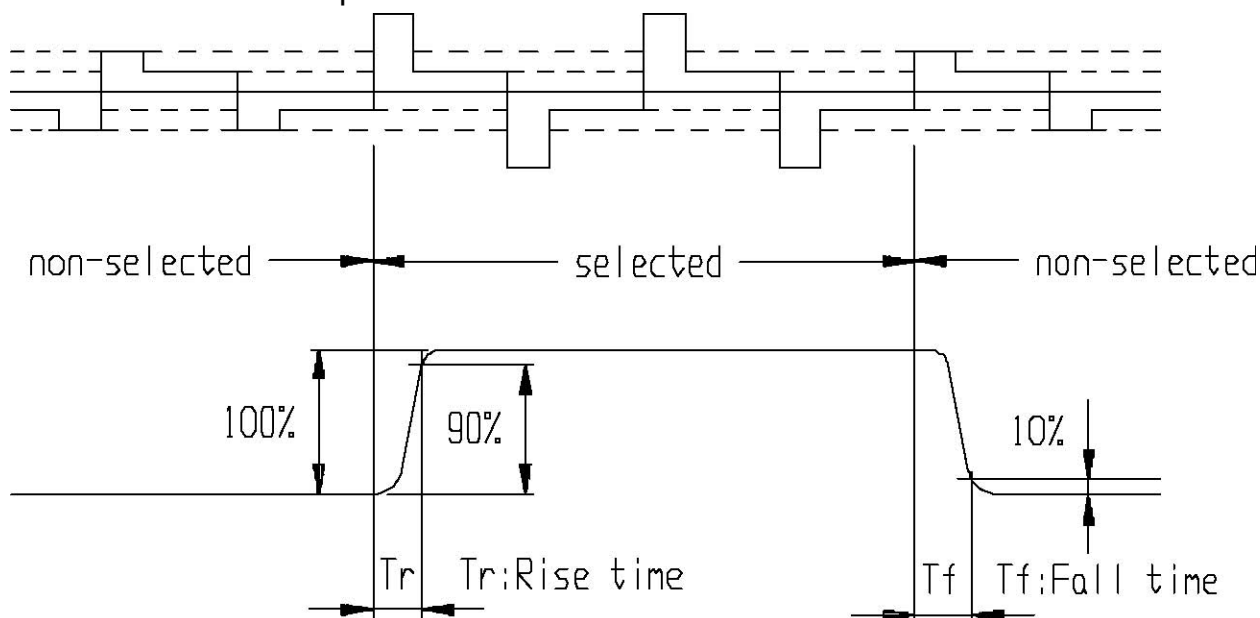
MPU Write Data to ST7920



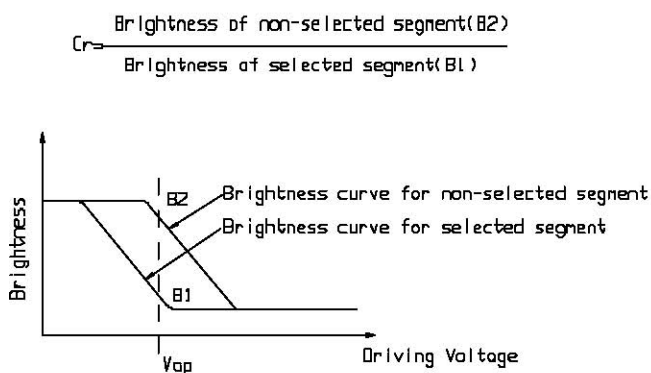
4. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response Time	Tr	-	-	-	-	ms	-	1
	Tf	-	-	-	-	ms	-	1
Contrast Ratio	Cr	-	-	-	-	-	-	2
Viewing Angle Range			-	-	-	deg	$\varnothing = 90$	3
	q	$Cr \geq 2$	-	-	-	deg	$\varnothing = 270$	3
			-	-	-	deg	$\varnothing = 0$	3
			-	-	-	deg	$\varnothing = 180$	3

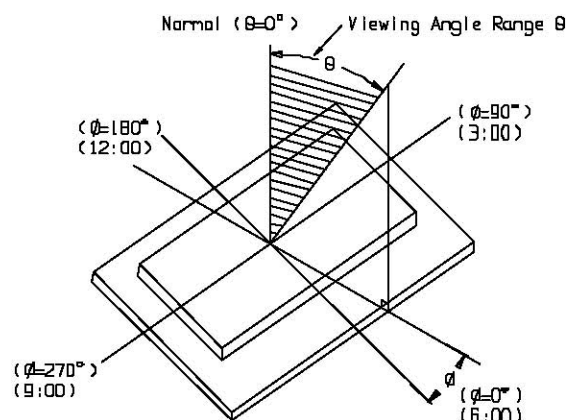
Note 1. Definition of response time



Note 2. Definition of Contrast Ratio 'Cr'



Note 3. Definition of Viewing Angle Range



5. Function Specifications

5.1. Resetting the LCD Module

The LCD module will be initialized, reset, after the power on. It is suggested to check the Busy Flag to ensure the reset procedure finish.

Functions	Initialized Status	
ENTER MODE SET	I/D=1 S=0	Cursor move to right DDRAM address counter (AC) plus 1
DISPLAY STATUS	D=0 C=0 B=0	Display=OFF Cursor=OFF Cursor position blink=OFF
FUNCTION SET	DL=1 RE=0	8bits Interface Basic Instruction Set
SCROLL OR RAM ADDR SELECT	SR=0	CGRAM address access is enable
REVERSE	R1=0,R0=0	First line normal
EXTENDED FUNCTION SET	G=0	Graphic Display OFF

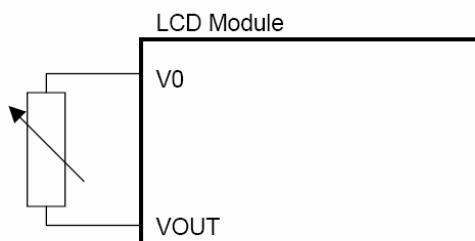
5.2. The Parallel interface

The parallel interface, 8-bit or 4-bit bus interface, could be selected by FUNCTION SET instruction DL bit.

In 4-bit bus interface, every 8-bit instruction/data is separated into two parts. First, transfer the higher 4-bits(DB7~DB4). Then transfer the lower 4-bits(DB3~DB0). They are transferred via DB7~DB4 terminals, where DB3~DB0 are not in used(leave open or pull high).

5.3. Adjusting the LCD display contrast

A Variable-Resistor may be connected to the LCD module for providing LCD Driving Voltage, VO. Adjusting the VR will result the change of LCD display contrast.



5.4. Display Memory Map

There are three main memory-areas in the LCD module for display.

- Character Generator RAM (CGRAM)
- Graphic Display RAM(GDRAM)
- Display Data RAM(DDRAM)

5.4.1. Character Generator RAM (CGRAM)

Character Generator RAM is for storing the User-defined Characters (a 16X16 dots font). There are only two characters could be defined.

The User-defined Character Codes are 0000h and 0002h. They could be called into DDRAM as normal character.

User-defined Character Code	CGRAM Address	CGRAM data	
		DB15~DB8	DB7~DB0
0000h	00h	16X16 Dot Font	
	01h		
	:		
	0Eh		
	0Fh		
0002h	00h	16X16 Dot Font	
	01h		
	:		
	0Eh		
	0Fh		

CGRAM Address Map

5.4.2. Graphics Display RAM(GDRAM)

GDRAM is for full graphics display. It could be displayed when G=1 (set by EXTENDED FUNCTION SET in Extended Instruction Set)

		Horizontal Address (X)				
		00h	01h	~	0eh	0fh
		D15 ~ D0	D15~D0	~	D15~D0	D15~D0
Vertical Address(Y)	00h	256X32 pixels				
	01h					
	:					
	:					
	1Eh					
	1Fh					

GDRAM Address Map

Note:

- *1. The mapping is based on Vertical Scroll Displacement Address=0
- *2. Another 256X32 Graphics Display RAM space is not showed. They could be displayed by adjusting the Vertical Scroll Displacements Address value.

5.4.3. Display Data RAM (DDRAM)

GB Character Code (16bit, A1A0h ~ F7FFh) could write into DDRAM for displaying the Simplified Chinese Character (16X16 dots font). User Characters (16bit, 0000h or 0002h) defined by user that stored in CGRAM could also be used. The display character should be on grid only.

		DDRAM Address (Low 4bit)												
		00h		01h		03h		~	0dh		0eh		0fh	
		H	L	H	L	H	L	~	H	L	H	L	H	L
DDRAM Address (Upper 4bit)	80h	16X2 Characters												
	90h	(16X16 dots font)												

DDRAM Address Map with 16X16 dots font

Note:

- *1. The mapping is based on Vertical Scroll Displacement Address=0
- *2. Another 16X2(Character) Display RAM space is not showed. They could be displayed by adjusting the Vertical Scroll Displacements Address value.

Standard ASCII code (8bit, 00h~7Fh) could write into DDRAM for displaying the half-width Character (8X16 dots font). The display character should be on grid only, and two characters should be written in each written in each write operation.

		DDRAM Address (Low 4bit)												
		00h		01h		03h		~	0dh		0eh		0fh	
		H	L	H	L	H	L	~	H	L	H	L	H	L
DDRAM Address (Upper 4bit)	80h	32X2 Characters												
	90h	(8X16 dots font)												

DDRAM Address Map with 8X16 dots font

Note:

- *1. The mapping is based on Vertical Scroll Displacement Address=0
- *2. Another 32X2(Character) Display RAM space is not showed. They could be displayed by adjusting the Vertical Scroll Displacements Address value.

5.5. Display Control instructions

5.5.1. Basic Instruction Set

Instruction set 1: (RE=0: basic instruction)

Ins	code										Description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
CLEAR	0	0	0	0	0	0	0	0	0	1	Fill DDRAM with "20H", and set DDRAM address counter AC to "00H"
HOME	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
ENTRY MODE	0	0	0	0	0	0	0	1	I/D	S	Set cursor position and display shift when doing write or read operation
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: display ON C=1: cursor ON B=1: blink ON
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
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	DL=1 8-BIT interface DL=0 4-BIT interface RE=1: extended instruction RE=0: basic instruction
SET CGRAM ADDR.	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)
SET DDRAM ADDR.	0	0	1	0 AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter (AC) AC6 is fixed to 0
READ BF & ADDR.	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)
WRITE RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to internal RAM (DDRAM/CGRAM/GDRAM)
READ RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/GDRAM)

Note:

*1. For the details of the Display Control Instructions, please refer to Sitronix ST7920 series datasheet.

*2. RE is the selection byte of basic and extended instruction set. Each time altering the value of RE, it will remain. Thus, it is not necessary to set RE every time when using the same group of instruction set.

5.5.2. Extended Instruction Set

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

Inst.	code										description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
STAND BY	0	0	0	0	0	0	0	0	0	1	Enter stand by mode, any other instruction can terminate (Com1..32 halted)
SCROLL or RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	SR=1: enable vertical scroll position SR=0: enable CGRAM address(basic instruction)
REVERSE	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 00
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
SET IRAM or SCROLL ADDR	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll
SET GRAPHIC RAM ADDR.	0	0	1	0 0	0 AC5	0 AC4	AC3 AC3	AC2 AC2	AC1 AC1	AC0 AC0	Set GDRAM address to address counter (AC) First set vertical address and the horizontal address by consecutive writing Vertical address range AC5...AC0 Horizontal address range AC3...AC0

Note:

*1. For the details of the Display Control Instructions, please refer to Sitronix ST7920 series datasheet.

*2. RE is the selection byte of basic and extended instruction set. Each time altering the value of RE, it will remain. Thus, it is not necessary to set RE every time when using the same group of instruction set.

6. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. Dropping from high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvent (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free from twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module exceed the absolute maximum ratings.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module.